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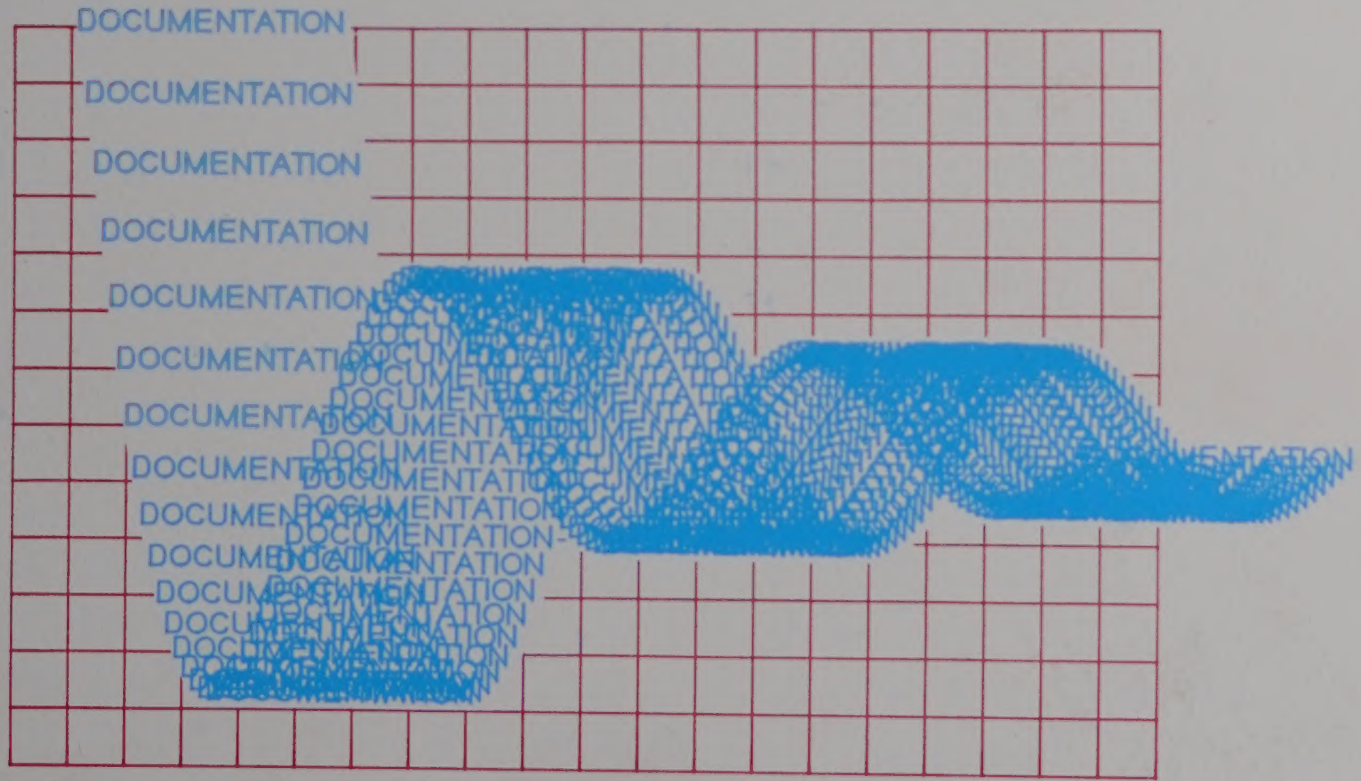

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Test and Measurement
Division

Operating Manual

3GPP FDD Base Station Test

Application Firmware Module FS-K72

1154.7000.02

Printed in the Federal
Republic of Germany

Dear Customer,

throughout this manual, FS-K72 is generally used as an abbreviation for the software option R&S FS-K72. The Spectrum Analyzer R&S FSU is abbreviated as FSU.

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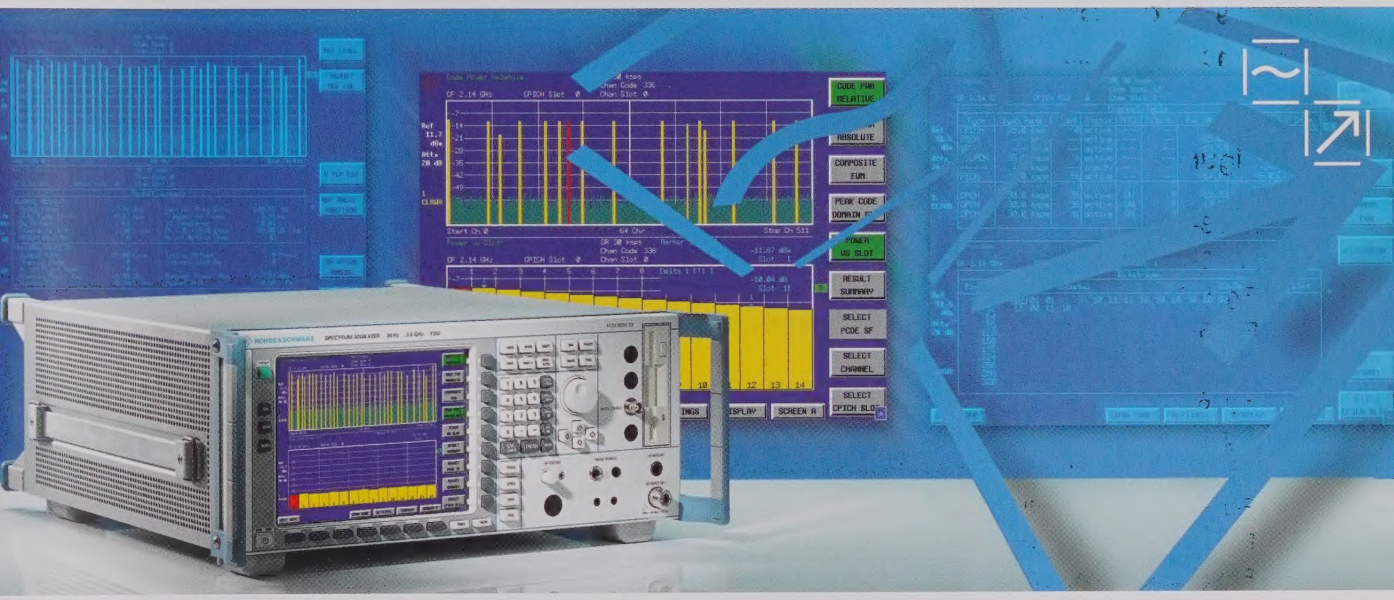

WCDMA 3GPP Application Firmware R&S FS-K72/-K73

3GPP transmitter measurements on base stations and modules with Signal Analyzer R&S FSQ and Spectrum Analyzers R&S FSU and R&S FSP

- Adds measurement functions to the R&S FSU, R&S FSQ and R&S FSP analyzer families in line with the 3GPP specifications for the FDD mode
- Application Firmware R&S FS-K72 provides the functionality needed for base station testing. Application Firmware R&S FS-K73 provides user equipment (UE) functionality:
  - Code domain power (code domain analyzer)
  - Code domain power versus time
  - Error vector magnitude (EVM)
  - Peak code domain error
  - Timing offset

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Application Firmware R&S FS-K72/-K73 can be installed on all models of the Signal Analyzer R&S FSQ and Spectrum Analyzers R&S FSU and R&S FSP, and enhances the range of applications to include code domain power and modulation measurements on 3GPP FDD signals.

Featuring wide dynamic range for adjacent channel power, the R&S FSU and the R&S FSQ are ideal tools for WCDMA base station transmitter measurements in development and production.

The R&S FSP is the ideal development tool with easy-to-use measurement functions integrated into a cost-effective analyzer, especially in mobile radio development.

Code domain power measurements

The main application of R&S FS-K72/-K73 is the determination of the power in the individual code channels referred to as code domain power measurement. The power ratios between the individual channels, for instance, can be checked for compliance with the nominal values. Moreover, this measurement is a very efficient tool for detecting impairments such as clipping or intermodulation that are not obvious from the spectrum alone. The power of the different codes is shown versus the code number.

To investigate power control, the power characteristic in a code channel can be displayed versus all slots of a frame (10 ms).

The R&S FSP requires the option R&S FSP-B70 to perform measurements over more than one slot in the code domain.

Measurement of modulation quality: peak code domain error and EVM

Two different measurements are stipulated in the 3GPP specifications for determining the modulation quality:

- EVM (error vector magnitude)
- Peak code domain error

The code domain power measurement offers an in-depth analysis for a WCDMA signal with several active channels. The composite EVM measurement returns a modulation error value for the total signal, whereas the symbol EVM function yields the individual vector errors of the active channels.

To obtain the peak code domain error (PCDE), the vector error between the measured signal and the ideal reference signal is determined and projected to the codes of a specific spreading factor. With R&S FS-K72, the spreading factor for the PCDE measurement can be selected by the user.

Automatic detection of active channels and their data rate

The scrambling code, which is user-selectable in the application firmware, must be known for the code domain power measurement. 3GPP FDD signals may use different spreading factors and data rates in the various channels. The data rates are automatically detected by R&S FS-K72/-K73 and need not be known beforehand.

Spectrum emission mask

To perform the spectrum emission mask measurement in line with the 3GPP specifications, the R&S FS-K72/-K73 provides an automatic function that gives a pass/fail result.

Spectrum measurements over wide dynamic range

The RMS detector integrated as standard allows precise transmitter power measurements irrespective of the waveform.

Owing to their extremely wide dynamic range, the R&S FSU and the R&S FSQ are the ideal analyzers for out-of-band emissions that have to be detected for instance by means of adjacent-channel power measurements. Noise correction yields a value of 84 dB in the adjacent channel which exceeds by far the values prescribed by the specification.

Measurement	R&S FSU/ FSP	R&S FSU/ FSP with R&S FS-K72	R&S FSU/ FSP with R&S FS-K73
Maximum output power	x		
CPICH power accuracy		x	N/A
Frequency error		x	x[1]
Power control dynamic range		x	
Total power dynamic range		x	N/A
Occupied bandwidth	x		
Spectrum emission mask	x	x	x
ACLR	x		
Spurious emissions	x		
Error vector magnitude		x	x
Peak code domain error		x	x

[1] Frequency relative to frequency received from BS.

Measurements cannot only be performed on systems but also on individual components such as amplifiers which have to meet more stringent requirements.

Remote control

All measurements can be remote-controlled. The results and demodulated data bits can be transferred via the IEEE bus. Ideal for use in production.

Other standards

Application Package R&S FS-K5 (GSM and EDGE measurements) turn the R&S FSP/R&S FSU/R&S FSQ into multi-standard signal analyzers for base stations as well as for mobiles.

Applications and examples

Code domain power measurement on a signal with 32 active channels (1)

Active and inactive channels are marked in different colours. Inactive channels (noise, interference) are displayed with the highest spreading factor.

The table also shows the main parameters of the total signal at a glance, e.g. total power, frequency error and error of chip rate, as well as the parameters of the marked code channel such as timing offset and code power.

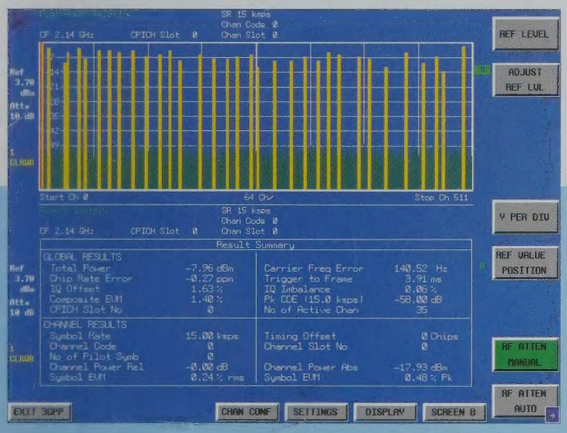
Peak code domain error measurement (2)

The peak code domain error is projected to the codes of the highest spreading factors. The maximum value of all codes per slot is displayed.

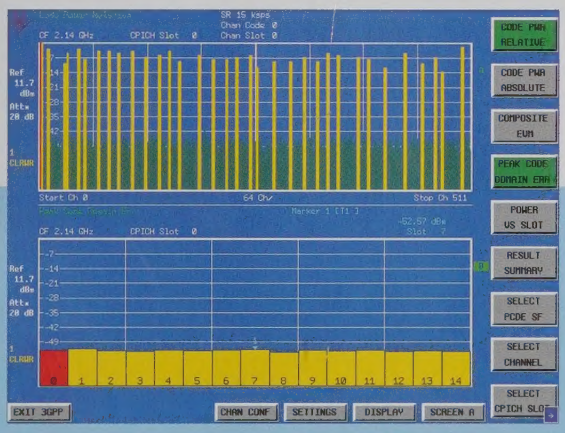
Automatic detection of channels and decoding of information (3)

Information about the active channels is presented in a list. In addition, the user data transmitted on each physical channel can be analyzed.

1



2



3

Measurement of code domain power versus time (4)

The code power can additionally be displayed versus the 15 slots of a frame to determine the accuracy of power control.

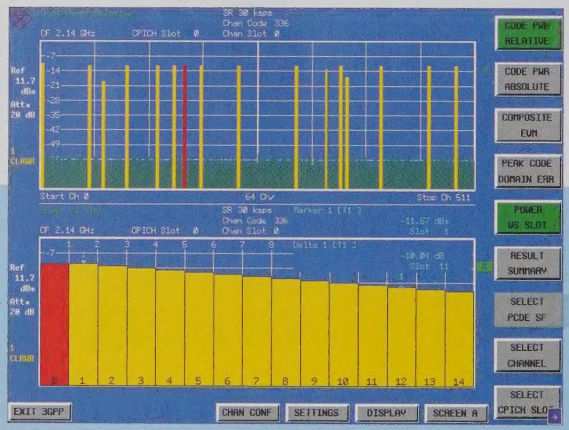
Spectrum emission mask measurement (5)

The measurement is defined with a 30 kHz measurement bandwidth at 2.5 MHz to 3.5 MHz offset from the carrier. From 3.5 MHz to 12.5 MHz , the measurement is performed in a 1 MHz measurement bandwidth. The limit values are according to 3GPP Specifications TS 34.121.

Multicode UE transmission (6)

The mapping of the active channels on the I and Q branches is automatically detected and displayed.

4



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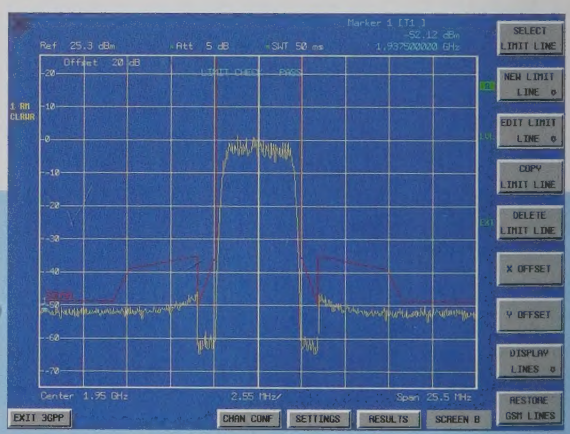
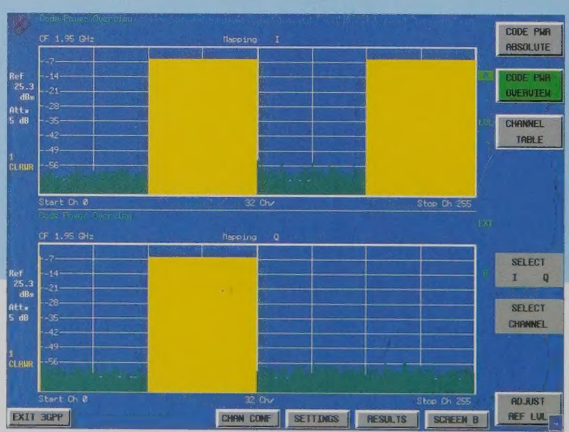


6



Specifications R&S FS-K72

The specifications below apply to the R&S FSQx (R&S FSQ3/8/26), R&S FSUx (R&S FSU3/8/26) und R&S FSPx (R&S FSP3/7/13/30/40). They are based on the data sheet specifications of the Spectrum Analyzers R&S FSQ, R&S FSU and R&S FSP and have not been checked separately. Specifications apply under the following conditions: 15 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and internal calibration performed. Data with tolerances are measurement uncertainties with a confidence level of 95%. The specified level measurement errors do not take into account systematic errors due to reduced S/N ratio.
The R&S FSPx analyzer has to be equipped with options R&S FSP-B15 and R&S FSP-B70.

Measurement	R&S FSP	R&S FSQ/R&S FSU	Test specifications and permissible measurement uncertainty of 3GPP TS 25.141
Code domain power (applies to code domain power and code domain power versus slot)			
Total signal power, measurement uncertainty	<0.5 dB	<0.3 dB	**6.2.1** <0.7 dB
CPICH power, measurement uncertainty	<0.6 dB	<0.4 dB	**6.2.2** <0.8 dB
Code power, measurement uncertainty Absolute Relative	<0.6 dB <0.1 dB	<0.4 dB <0.1 dB	<0.1 dB
Frequency error Measurement range Measurement uncertainty (S/N >40 dB)	<1 kHz <1.5 Hz + error of reference frequency	<1 kHz <1.5 Hz + error of reference frequency	**6.3, 6.7.1** <12 Hz
Composite EVM			
Measurement range	2% to 25%	1.5% to 25%	12.5% to 25%
Inherent EVM	<2%	<1.5%	
Measurement uncertainty	<1%	<0.5%	<2.5%
Peak code domain error			**6.7.3**
Measurement range	0 dB to –55 dB	0 dB to –60 dB	–33 dB
Inherent PCDE	–55 dB	–60 dB	
Measurement uncertainty	<1 dB (0 dB to 40 dB)	<1 dB (0 dB to 40 dB)	<1 dB
Output power			**6.2.1**
Measurement uncertainty Absolute Relative	<0.5 dB <0.2 dB	<0.3 dB <0.1 dB	<0.7 dB
Occupied bandwidth (99 %)			**6.5.1**
Measurement uncertainty	<85 kHz	<85 kHz	<100 kHz
ACLR (adjacent-channel leakage ratio) (3.84 MHz BW)			**6.5.2.2**
5 MHz offset			45 dB
Dynamic range Without noise correction	65 dB	77 dB	
Measurement uncertainty	<0.3 dB + error due to S/N	<0.2 dB + error due to S/N	<0.8 dB
Spurious emissions			**6.5.2.3**
Level uncertainty <3.6 GHz 3.6 GHz to 13 GHz	<0.5 dB <2.5 dB	<0.5 dB <2.5 dB	
Spectrum emission mask	<1.5 dB	<1 dB	<1.5 dB

Specifications R&S FS-K73

The specifications below apply to the R&S FSQx (R&S FSQ3/8/26), R&S FSUx (R&S FSU3/8/26) und R&S FSPx (R&S FSP3/7/13/30/40). They are based on the data sheet specifications of Spectrum Analyzers R&S FSP and R&S FSU, and have not been checked separately. Specifications apply under the following conditions: 15 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and internal calibration performed. Data with tolerances are measurement uncertainties with a confidence level of 95%. Data without tolerances are typical values. The specified level measurement errors do not take into account systematic errors due to reduced S/N ratio.
The R&S FSPx analyzer has to be equipped with option R&S FSP-B15.

Measurement	R&S FSP	R&S FSQ/R&S FSU	Test specifications and permissible measurement uncertainty to 3GPP TS 34.121
Code domain power (applies to code domain power and code domain power vs slot)			
Maximum output power	<0.5 dB	<0.3 dB	**5.2** <0.7 dB
Minimum output power	<0.5 dB	<0.4 dB	**5.4.3** <1 dB
Code power; measurement uncertainty Absolute Relative	<0.6 dB <0.1 dB <0.3 dB	<0.4 dB <0.1 dB <0.3 dB	<0.1 dB over a 1.5 dB range <0.3 dB over a 12 dB range
Frequency error Measurement range Measurement uncertainty (S/N > 40 dB)	<1 kHz <1.5 Hz + error of reference frequency	<1 kHz <1.5 Hz + error of reference frequency	**5.3** <10 Hz
Composite EVM			
Measurement range	2% to 25%	1.5% to 25%	12.5% to 25%
Inherent EVM	<2%	<1.5%	
Measurement uncertainty	<1%	<0.5%	0%
Peak code domain error			**5.13**
Measurement range	0 dB to –55 dB	0 dB to –60 dB	–15 dB
Inherent PCDE	–55 dB	–60 dB	
Measurement uncertainty	<1 dB (0 dB to 40 dB)	<1 dB (0 dB to 40 dB)	<1 dB
Output power			**5.2**
Measurement uncertainty Absolute Relative	<0.5 <0.2	<0.3 dB <0.1 dB	<0.7 dB
Occupied bandwidth (99 %)			**5.8**
Measurement uncertainty	<85 kHz	<85 kHz	<100 kHz
ACLR (adjacent-channel leakage ratio) (3.84 MHz BW), test model 1 with 32 DPCH			**6.5.2.2**
5 MHz offset			32.2 dB
Dynamic range Without noise correction	65 dB	77 dB	
Measurement uncertainty	<0.3 dB + error due to S/N	<0.2 dB + error due to S/N	<0.8 dB
Spurious emissions			
Level uncertainty <3.6 GHz 3.6 GHz to 13 GHz	<0.5 dB <2.5 dB	<0.5 dB <2.5 dB	
Spectrum emission mask	<1.5 dB	<1 dB	<1.5 dB

Configuration overview

	Base station		User equipment (UE)	
	R&S FSQ/R&S FSU	R&S FSP	R&S FSQ/R&S FSU	R&S FSP
R&S FS-K72	●	●		
R&S FS-K73			●	●
R&S FSP-B15		●		●
R&S FSP-B70		●		○[1]

[1] Extends measurement range from one slot to one frame.

Ordering information

R&S FS-K72

Application Firmware R&S FS-K72 can be integrated into any member of the R&S FSU and R&S FSQ family. Options R&S FSP-B70 and option R&S FSP-B15 are prerequisites for operating the application firmware on any member of the R&S FSP spectrum analyzer family.

Designation	Type	Order No.
WCDMA 3GPP Application Firmware	R&S FS-K72	1154.7000.02
Pulse Calibrator for R&S FSP	R&S FSP-B15	1155.1006.02
Demodulator Hardware for R&S FSP	R&S FSP-B70	1157.0559.02

R&S FS-K73

Application Firmware R&S FS-K73 can be integrated into any member of the R&S FSQ & R&S FSU family. Option R&S FSP-B15 is a prerequisite for operating the application firmware on any member of the R&S FSP spectrum analyzer family.

Designation	Type	Order No.
WCDMA 3GPP Application Firmware	R&S FS-K73	1154.7252.02
Pulse Calibrator for R&S FSP	R&S FSP-B15	1155.1006.02

Recommended extras

R&S FSP-B70 extends the measurement range of the Application Firmware R&S FS-K73 for the Spectrum Analyzer R&S FSP from one slot to one frame.

Designation	Type	Order No.
Demodulator Hardware for R&S FSP	R&S FSP-B70	1157.0559.02

Certified Environmental System ISO 14001 REG. NO 1954

Certified Quality System ISO 9001 DQS REG. NO 1954

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Safety Instructions

This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

Safety-related symbols used on equipment and documentation from R&S:

Observe operating instructions

Weight indication for units >18 kg

PE terminal

Ground terminal

Danger! Shock hazard

Warning! Hot surfaces

Ground

Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   IP degree of protection 2X, pollution severity 2 overvoltage category 2, only for indoor use, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

   Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

continued overleaf

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.
11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. The outside of the instrument is suitably cleaned using a soft, lint-free dustcloth. Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.
15. Any additional safety instructions given in this manual are also to be observed.

Certified Quality System

ISO 9001

DQS REG. NO 1954-04

Qualitätszertifikat

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

Certificate of quality

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to ISO 9001.

Certificat de qualité

Cher client,

Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément à la norme ISO 9001.

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Support Center

Telefon / Telephone: **(0180) 512 42 42**

Fax: **(++89) 41 29 - 137 77**

e-mail: **CustomerSupport@rsd.rohde-schwarz.com**

Für technische Fragen zu diesem Rohde & Schwarz-Gerät steht Ihnen ab sofort unsere Hotline der Rohde & Schwarz Vertriebs-GmbH, Support Center, zur Verfügung.

Unser Team bespricht mit Ihnen Ihre Fragen und sucht Lösungen für Ihre Probleme.

Die Hotline ist Montag bis Freitag von 8.00 bis 17.00 Uhr besetzt.

Bei Anfragen außerhalb der Geschäftszeiten hinterlassen Sie bitte eine Nachricht oder senden Sie eine Notiz per Fax oder e-mail. Wir setzen uns dann baldmöglichst mit Ihnen in Verbindung.

Möchten Sie über Neuerungen und Updates zu einem bestimmten Gerät informiert werden, senden Sie bitte eine kurze e-mail unter Angabe des Gerätes. Sie erhalten dann regelmäßig die aktuellen Informationen zugesandt.

Should you have any technical questions concerning this Rohde & Schwarz product, please contact the hotline of Rohde & Schwarz Vertriebs-GmbH, Support Center.

Our hotline team will answer your questions and find solutions to your problems.

You can reach the hotline Monday through Friday from 8:00 until 17:00.

If you need assistance outside office hours, please leave a message or send us a fax or e-mail. We will contact you as soon as possible.

If you wish to receive the latest news about and updates for a specific instrument, please send us a short e-mail indicating the instrument. We will then send you up-to-date information on a regular basis.

ROHDE&SCHWARZ

1007.8684.14-01.00

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Contents of Manual for Application Firmware FS-K72

This manual contains all information on the operation of FSU equipped with Application Firmware FS-K72. It includes operation via menus and the remote-control commands for the 3GPP FDD base station test.

The manual comprises the data sheet and 10 chapters:

The data sheet	informs on the guaranteed specifications and the firmware characteristics.
Chapter 1	describes how to enable the application firmware module.
Chapter 2	describes typical examples of measurements by means of tests.
Chapter 3	describes the measurement setup for base station tests.
Chapter 4	describes the 3GPP FDD test models as stipulated in BTS test (3G TS 25.141 V3.7.0).
Chapter 5	gives a schematic overview of the FS-K72 control menus.
Chapter 6	contains a detailed description of the possible base station test measurements as a reference for manual operation. The chapter also presents a list of remote-control commands associated with each function.
Chapter 7	describes all remote-control commands defined for the code domain measurement. An alphabetic list of all remote-control commands and a table of softkeys with the assignment of commands are given at the end of this chapter.
Chapter 8	contains the performance test.
Chapter 9	contains an explanation of terms related to measured quantities of the code domain measurement.
Chapter 10	contains the index of this operating manual.

This manual is a supplement to the FSU operating manual. It includes exclusively functions of Application Firmware FS-K72. For all other descriptions, please refer to the FSU operating manual.

3GPP FDD Base Station Test - Application Firmware FS-K72

Signal analyzer FSU equipped with Application Firmware FS-K72 performs code domain power measurements on downlink signals according to standard 3GPP (FDD mode). The application firmware is in line with standard 3GPP (Third Generation Partnership Project) with version Release 99. In addition to the code domain measurements prescribed by the standard 3GPP, the application offers measurements with predefined settings in the frequency domain, e.g. power and ACLR measurement.

1 Enabling the Firmware Option

Firmware Option FS-K72 is enabled in the *GENERAL SETUP* menu by entering a keyword. The keyword is delivered with the option. If the option is factory-installed, it is already enabled.

GENERAL SETUP menu:

The *OPTIONS* softkey opens a submenu where keywords for new firmware options (application firmware modules) can be entered. Available options are displayed in a table, which is opened when entering the submenu.

The *INSTALL OPTION* softkey activates the entry of the keyword for a firmware option.

One ore several keywords can be entered in the entry field. On entering a valid keyword, *OPTION KEY OK* is displayed on the message line and the option is entered in the *FIRMWARE OPTIONS* table.

In case of invalid keywords, *OPTION KEY INVALID* is displayed on the message line.

2 Getting Started

The following chapter explains basic 3GPP FDD base station tests by means of a setup with Signal Generator SMIQ. It describes how operating and measurement errors can be avoided using correct presetting.
The measurement screen is presented in chapter 6 for each measurement.

Key settings are shown as examples to avoid measurement errors. Following the correct setting, the effect of an incorrect setting is shown. The following measurements are performed:

- Measurement 1: Measuring the spectrum
- Measurement 2: Measurement of spectrum emission mask
- Measurement 3: Measurement of relative code domain power
  - Setting: Setting the analyzer center frequency to the DUT frequency
  - Setting: Scrambling code of signal
- Measurement 4: Triggered measurement of relative code domain power
  -Setting: Trigger offset
- Measurement 5: Measurement of composite EVM
- Measurement 6: Measurement of peak code domain error

The measurements are performed using the following units and accessories:

- Signal Analyzer FSU with Application Firmware FS-K72: 3GPP FDD base station test
- Vector Signal Generator SMIQ with option SMIQB45: digital standard 3GPP (options SMIQB20 and SMIQB11 required)
- 1 coaxial cable, 50 Ω, approx. 1 m, N connector
- 1 coaxial cable, 50 Ω, approx. 1 m, BNC connector

Conventions for displaying settings on FSU:

[***<KEY>***]	Press a key on the front panel, e.g. ***[SPAN]***
[<SOFTKEY>]	Press a softkey, e.g. *[MARKER -> PEAK]*
[<nn unit>]	Enter a value and terminate by entering the unit, e.g. *[12 kHz]*

Conventions for displaying settings on SMIQ:

[***<KEY>***]	Press a key on the front panel, e.g. ***[FREQ]***
<MENU>	Select a menu, parameter or a setting, e.g. *DIGITAL STD.* The menu level is marked by an indentation.
<nn unit>	Enter a value and terminate by entering the unit, e.g. *12 kHz*

Basic Settings in Code Domain Measurement Mode

In the default setting after PRESET, FSU is in the analyzer mode. The following default settings of the code domain measurement are activated, provided the code domain measurement mode is selected.

Table 2-1 Default settings of the code domain measurement

Parameter	Setting
Digital standard	W-CDMA 3GPP FWD
Sweep	CONTINUOUS
CDP mode	CODE CHAN AUTOSEARCH
Trigger settings	FREE RUN
Trigger offset	0
Scrambling code	0
Threshold value	-60 dB
Symbol rate	15 ksps
Code number	0
Slot number	0
Display	Screen A: CODE PWR RELATIVE Screen B: RESULT SUMMARY

Measurement 1: Measuring the Signal Power

The measurement of the spectrum gives an overview of the 3GPP FDD signal and the spurious emissions close to the carrier.

Test setup

➢ Connect the RF output of SMIQ to the RF input of FSU (coaxial cable with N connectors).

Settings on SMIQ:

[PRESET]
[LEVEL: *0 dBm]*
[FREQ: *2.1175 GHz]*
DIGITAL STD
WCDMA/3GPP
TEST MODELS ...
TEST1_32
STATE: ON

Settings on FSU:

[PRESET]
[CENTER: *2.1175 GHz]*
[AMPT: *0 dBm]*
[3G FDD BS]
[MEAS: *POWER]*

Measurement on FSU:

The following is displayed:

- The spectrum of the WCDMA signal on the trace
- The signal channel power within the 3.84 MHz channel bandwidth (in the marker info field)

Measurement 2: Measurement of Spectrum Emission Mask

The 3GPP specification defines a measurement, which monitors the compliance with a spectral mask in a range of at least ±12.5 MHz about the WCDMA carrier. To assess the power emissions in the specified range, the signal power is measured in the range near the carrier by means of a 30 kHz filter, in the ranges far off the carrier by means of a 1 MHz filter. The resulting trace is compared to a limit line defined in the 3GPP specification.

Test setup

➢ Connect the RF output of SMIQ to the RF input of FSU (coaxial cable with N connectors).

.

Settings on SMIQ:

[PRESET]
[LEVEL: *0 dBm]*
[FREQ: *2.1175 GHz]*
DIGITAL STD
WCDMA/3GPP
TEST MODELS ...
TEST1_32
STATE: ON

Settings on FSU:

[PRESET]
[CENTER: *2.1175 GHz]*
[AMPT: *0 dBm]*
[3G FDD BS]
[MEAS: *SPECTRUM EM MASK]*

Measurement on FSU:

The following is displayed:

- Spectrum of the 3GPP FDD signal
- Limit line defined in the standard
- Information on limit line violations (passed/failed)

Measurement 3: Measurement of Relative Code Domain Power

A code domain power measurement on one of the test models (model 1 with 32 channels) is shown in the following. To demonstrate the effects the basic parameters of CDP measurements which allow an analysis of the signal are changed one after the other from values adapted to the measurement signal to non-adapted values.

Test setup
- ➢ Connect the RF output of SMIQ to the input of FSU
- ➢ Connect the reference input (EXT REF IN/OUT) on the rear panel of the analyzer to the reference input (REF) on the rear panel of SMIQ (coaxial cable with BNC connectors).

Settings on SMIQ:
[PRESET]
[LEVEL: *0 dBm]*
[FREQ: *2.1175 GHz]*
DIGITAL STD
WCDMA 3GPP
TEST MODELS ...
TEST1_32
STATE: ON

Settings on FSU:
[PRESET]
[CENTER: *2.1175 GHz]*
[AMPT: *10 dBm]*
[3G FDD BS]
[SETTINGS: SCRAMBLING CODE 0]

Measurement on FSU: The following is displayed:
Screen A: Code domain power of signal (test model 1 with 32 channels)
Screen B: Numeric results of CDP measurement

Setting: Synchronizing the reference frequencies

The synchronization of the reference oscillators both of the DUT and analyzer strongly reduces the measured frequency error.

Test setup
- ➢ Connect the reference input (EXT REF IN/OUT) on the rear panel of the analyzer to the reference output (REF) on the rear panel of SMIQ (coaxial cable with BNC connectors).

Settings on SMIQ: *As for measurement 2*

Settings on FSU: *As for measurement 2, plus*
[SETUP: *REFERENCE EXT]*

Measurement on FSU: Frequency error The displayed frequency error should be < 10 Hz.

The reference frequencies of the analyzer and of the DUT should be synchronized

Setting: Behaviour with Deviating Center Frequency Setting

In the following, the behaviour of the DUT and the analyzer with wrong center frequency setting is shown.

Settings on SMIQ: ➢ Tune the center frequency of the signal generator in 0.5 kHz steps and watch the analyzer screen:

Measurement on FSU:
- A CDP measurement on the analyzer is still possible with a frequency error of up to approx. 1 kHz. Up to 1 kHz, a frequency error causes no apparent difference in measurement accuracy of the code domain power measurement.
- Above a frequency error of 1 kHz, the probability of an impaired synchronization increases. With continuous measurements, at times all channels are displayed in blue with almost the same level.
- Above a frequency error of approx. 2 kHz, a CDP measurement cannot be performed. FSU displays all possible codes in blue with a similar level.

Settings on SMIQ: ➢ Set the signal generator center frequency again to 2.1175 GHz:
[FREQ: *2.1175 GHz]*

The analyzer center frequency should not differ from the DUT frequency by more than 2 kHz.

Setting: Behaviour with Incorrect Scrambling Code

A valid CDP measurement can only be carried out if the scrambling code set on the analyzer is identical to the one of the transmitted signal.

Test setup *SELECT BS/MS*
BS 1: ON
SCRAMBLING CODE: 0001
(the scrambling code is set to 0000 on the analyzer)

Settings on SMIQ: The CDP display shows all possible codes with approximately the same level.

Settings on FSU: Set scrambling code to new value:
[SETTINGS: *SCRAMBLING CODE 1]*

Measurement on FSU: The CDP display again shows the test model.

The scrambling code setting of the analyzer must be identical to that of the measured signal.

Measurement 4: Triggered Measurement of Relative Code Domain Power

If the code domain power measurement is performed without external triggering, a section of approximately 20 ms of the test signal is recorded at an arbitrary moment to detect the start of a 3GPP FDD frame in this section. Depending on the position of the frame start, the required computing time can be quite long. Applying an external (frame) trigger can reduce the computing time.

Test setup

- Connect the RF output of SMIQ to the input of FSU
- Connect the reference input (EXT REF IN/OUT) on the rear panel of FSU to the reference input (REF) on the rear panel of SMIQ (coaxial cable with BNC connectors).
- Connect the external trigger input on the rear panel of FSU (EXT TRIG GATE) to the external trigger output on the rear panel of SMIQ (TRIGOUT1 of PAR DATA).

Settings on SMIQ: *As for measurement 3*

Settings on FSU: *As for measurement 3, plus*
[TRIG *EXTERN]*

Measurement on FSU: The following is displayed:
Screen A: Code domain power of signal
(test model 1 with 32 channels)
Screen B: Numeric results of CDP measurement

Trigger to Frame:
Offset between trigger event and start of 3GPP FDD frame

The repetition rate of the measurement increases considerably compared to the repetition rate of a measurement without external trigger.

Setting: Trigger offset

A delay of the trigger event referred to the start of the 3GPP FDD frame can be compensated by modifying the trigger offset.

Settings on FSU: *TRIG* *TRIGGER OFFSET* *100 µs]*

Measurement on FSU: The parameter Trigger to Frame in the numeric results table (screen B) changes:
Trigger to Frame *-100 µs*

A trigger offset compensates analog delays of the trigger event.

Measurement 5: Measurement of Composite EVM

The 3GPP specification prescribes the composite EVM measurement as the average square deviation of the total signal:
An ideal reference signal is generated from the demodulated data. The test signal and the reference signal are compared with each other. The square deviation yields the composite EVM.

Test setup

- Connect the RF output of SMIQ to the input of FSU
- Connect the reference input (EXT REF IN/OUT) on the rear panel of FSU to the reference input (REF) on the rear panel of SMIQ (coaxial cable with BNC connectors).
- Connect the external trigger input on the rear panel of FSU (EXT TRIG GATE) to the external trigger output on the rear panel of SMIQ (TRIGOUT1 of PAR DATA).

Settings on SMIQ:

[PRESET]
[LEVEL: *0 dBm]*
[FREQ: *2.1175 GHz]*
DIGITAL STD
WCDMA 3GPP
TEST MODELS ...
TEST4
SELECT BS/MS
BS 1 ON
CPICH STATE ON
STATE: ON

Settings on FSU:

[PRESET]
[CENTER: *2.1175 GHz]*
[REF: *10 dBm]*
[3G FDD BS]
[TRIG *EXTERN]*
[RESULTS *COMPOSITE EVM]*

Measurement on FSU: The following is displayed:

Screen A: Code domain power of signal (Test model 4)
Screen B: Composite EVM (EVM for total signal)

Measurement 6: Measurement of Peak Code Domain Errors

The peak code domain error measurement is defined in the 3GPP specification for WCDMA signals. An ideal reference signal is generated from the demodulated data. The test signal and the reference signal are compared with each other. The difference of the two signals is projected onto the classes of the different spreading factors. The peak code domain error measurement is obtained by summing up the symbols of each difference signal slot and searching for the maximum error code.

Test setup

- Connect the RF output of SMIQ to the input of FSU
- Connect the reference input (EXT REF IN/OUT) on the rear panel of FSU to the reference input (REF) on the rear panel of SMIQ (coaxial cable with BNC connectors).
- Connect the external trigger input on the rear panel of FSU (EXT TRIG GATE) to the external trigger output on the rear panel of SMIQ (TRIGOUT1 of PAR DATA).

Settings on SMIQ:

[PRESET]
[LEVEL: *0 dBm]*
[FREQ: *2.1175 GHz]*
DIGITAL STD
WCDMA 3GPP
TEST MODELS ...
TEST1_32
STATE: ON

Settings on FSU:

[PRESET]	
[CENTER:	*2.1175 GHz]*
[REF:	*0 dBm]*
[3G FDD BS]	
[TRIG	*EXTERN]*
[RESULTS	*PEAK CODE DOMAIN ERR]*
	SELECT PCDE SF 256

Measurement on FSU: The following is displayed:

Screen A: Code domain power of signal (test model 1 with 32 channels)

Screen B: Peak code domain error (projection of the error onto the class with spreading factor 256

3 Setup for Base Station Tests

Caution:

Before turning the instrument on, the following conditions must be fulfilled:

- *Instrument covers are in place and all fasteners are tightened.*
- *Fan openings are free from obstructions.*
- *Signal levels at the input connectors are all below specified maximum values.*
- *Signal outputs are correctly connected and not overloaded.*

Non-compliance with these instructions may cause damage to the instrument.

This section describes how to set up the analyzer for 3GPP FDD base station tests. As a prerequisite for starting the test, the instrument must be correctly set up and connected to the AC power supply as described in chapter 1 of the operating manual for the analyzer. Furthermore, the application firmware module must be properly installed following the instructions given in chapter 1 of the present manual.

Standard Test Setup

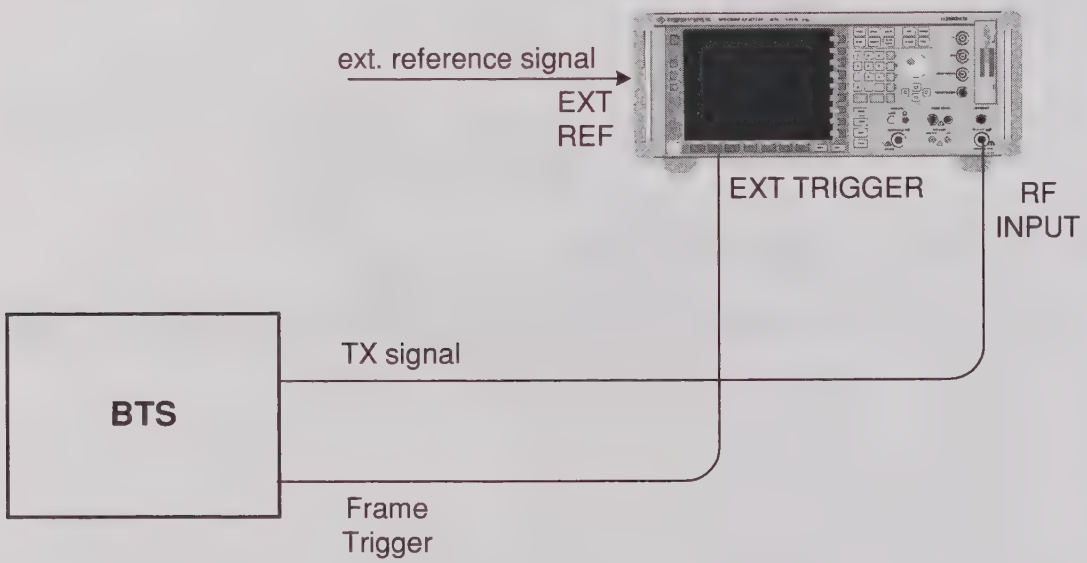


Fig. 3-1 BTS test setup

➢ Connect antenna output (or TX output) of BTS to RF input of the analyzer via a power attenuator of suitable attenuation.

The following values are recommended for the external attenuator to ensure that the RF input of the analyzer is protected and the sensitivity of the analyzer is not reduced too much.

Max. power	Recommended ext. attenuation
≥ 55 to 60 dBm	35 to 40 dB
≥ 50 to 55 dBm	30 to 35 dB
≥ 45 to 50 dBm	25 to 30 dB
≥ 40 to 45 dBm	20 to 25 dB
≥ 35 to 40 dBm	15 to 20 dB
≥ 30 to 35 dBm	10 to 15 dB
≥ 25 to 30 dBm	5 to 10 dB
≥ 20 to 25 dBm	0 to 5 dB
< 20 dBm	0 dB

- For signal measurements at the output of two-port networks, connect the reference frequency of the signal source to the rear reference input of the analyzer (*EXT REF IN/OUT*).

  To ensure that the error limits specified by the 3GPP standard are met, the analyzer should use an external reference frequency for frequency measurements on base stations. A rubidium frequency standard may be used for instance as a reference source.

- If the base station is provided with a trigger output, connect this output to the rear trigger input of the analyzer (*EXT TRIG GATE*).

Presetting

- Enter external attenuation (REF LVL OFFSET)
- Enter reference level
- Enter center frequency
- Set the trigger
- Select standard and measurement

4 3GPP FDD Test Models

For measurements on base-station signals in line with 3GPP, test models with different channel configuration are specified in the document "Base station conformance testing (FDD)" (3GPP TS 25.141 V3.7.0). An overview of the test models is given in this chapter.

The channel configurations of test models 1 to 3 contain the special channel SCCPCH. This channel can only be automatically detected in CDP analysis if it contains pilot symbols. For measurements on signals with SCCPCH without pilot symbols, the CDP analysis must be performed in the *CODE CHAN PREDEFINED* mode. In this mode the 3GPP test models can be used for the measurement at a keystroke (see softkey *CODE CHAN PREDEFINED* for a detailed description).

Table 4-1 Test model 1

Channel type	Number of channels	Power (%)	Level (dB)	Spreading code	Timing offset ($x256T_{chip}$)
PCCPCH+SCH	1	10	-10	1	0
Primary CPICH	1	10	-10	0	0
PICH	1	1.6	-18	16	120
SCCPCH (SF=256)	1	1.6	-18	3	0
DPCH (SF=128)	16/32/64	76.8 total	see TS 25.141	see TS 25.141	see TS 25.141

Table 4-2 Test model 2

Channel type	Number of channels	Power(%)	Level (dB)	Spreading code	Timing offset ($x256T_{chip}$)
PCCPCH+SCH	1	10	-10	1	0
Primary CPICH	1	10	-10	0	0
PICH	1	5	-13	16	120
SCCPCH (SF=256)	1	5	-13	3	0
DPCH (SF=128)	3	2 x 10,1 x 50	2 x –10, 1 x –3	24, 72, 120	1, 7, 2

Table 4-3 Test model 3

Channel type	Number of channels	Power (%) 16/32	Level (dB) 16/32	Spreading code	Timing offset (x256T_{chip})
PCCPCH+SCH	1	12,6/7,9	-9 / -11	1	0
Primary CPICH	1	12,6/7,9	-9 / -11	0	0
PICH	1	5/1.6	-13 / -18	16	120
SCCPCH (SF=256)	1	5/1.6	-13 / -18	3	0
DPCH (SF=256)	16/32	63,7/80,4 total	see TS 25.141	see TS 25.141	see TS 25.141

Table 4-4 Test model 4

Channel type	Number of channels	Power (%) 16/32	Level (dB) 16/32	Spreading code	Timing offset (x256T_{chip})
PCCPCH+SCH	1	50 to 1.6	-3 to -18	1	0
Primary CPICH*	1	10	-10	0	0

* The CPICH is optional.

5 Menu Overview

Application Firmware Module FS-K72 (3GPP FDD base station test) extends the analyzer by the code domain measurement mode for 3GPP FDD standard. Additional softkeys are available which allow overview measurements in the analyzer mode.

The FS-K72 application is started by a click on the 3G FDD BS hotkey:

The main settings of the code domain power measurements can be directly selected via the hotkey bar that changes after the application has been started.
When one of the *CHAN CONF*, *SETTINGS*, *RESULTS* hotkeys is selected, the measurement is automatically switched to the Code Domain Power measurement mode.
If the *EXIT 3GPP* hotkey is selected, FS-K72 is exited. The hotkey bar of the basic unit is displayed again.

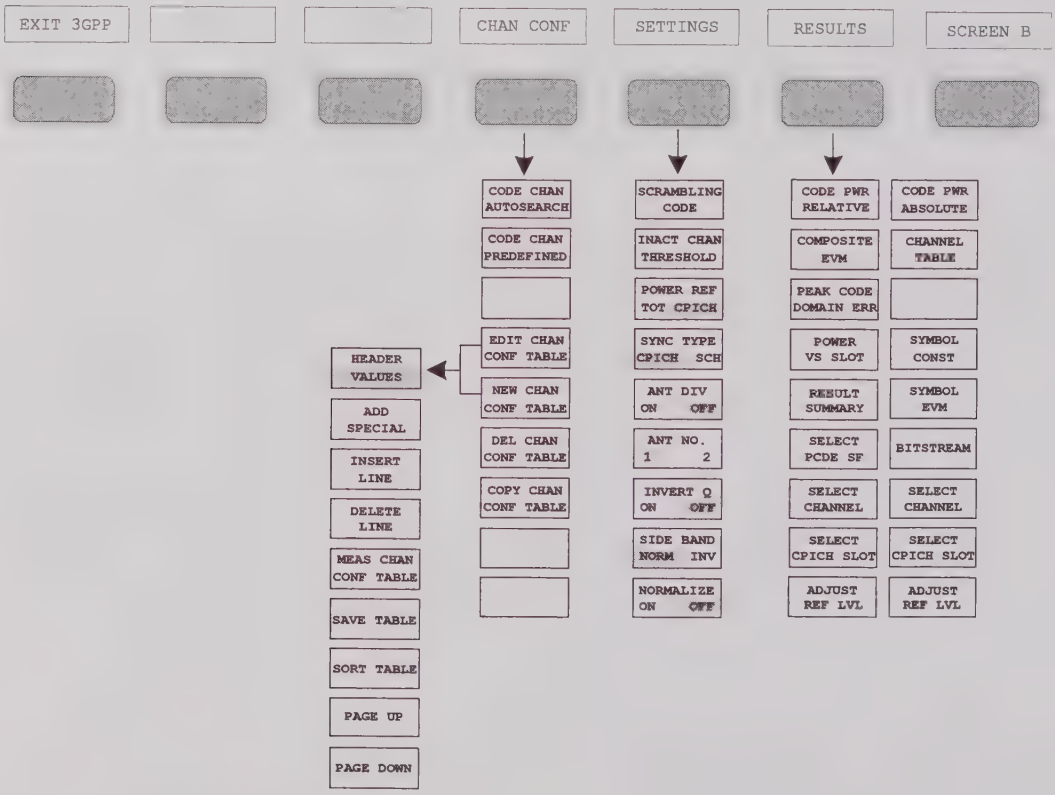


Fig. 5-1 Overview of menus - code domain power

The measurements available in FS-K72 can be selected by means of the MEAS key:

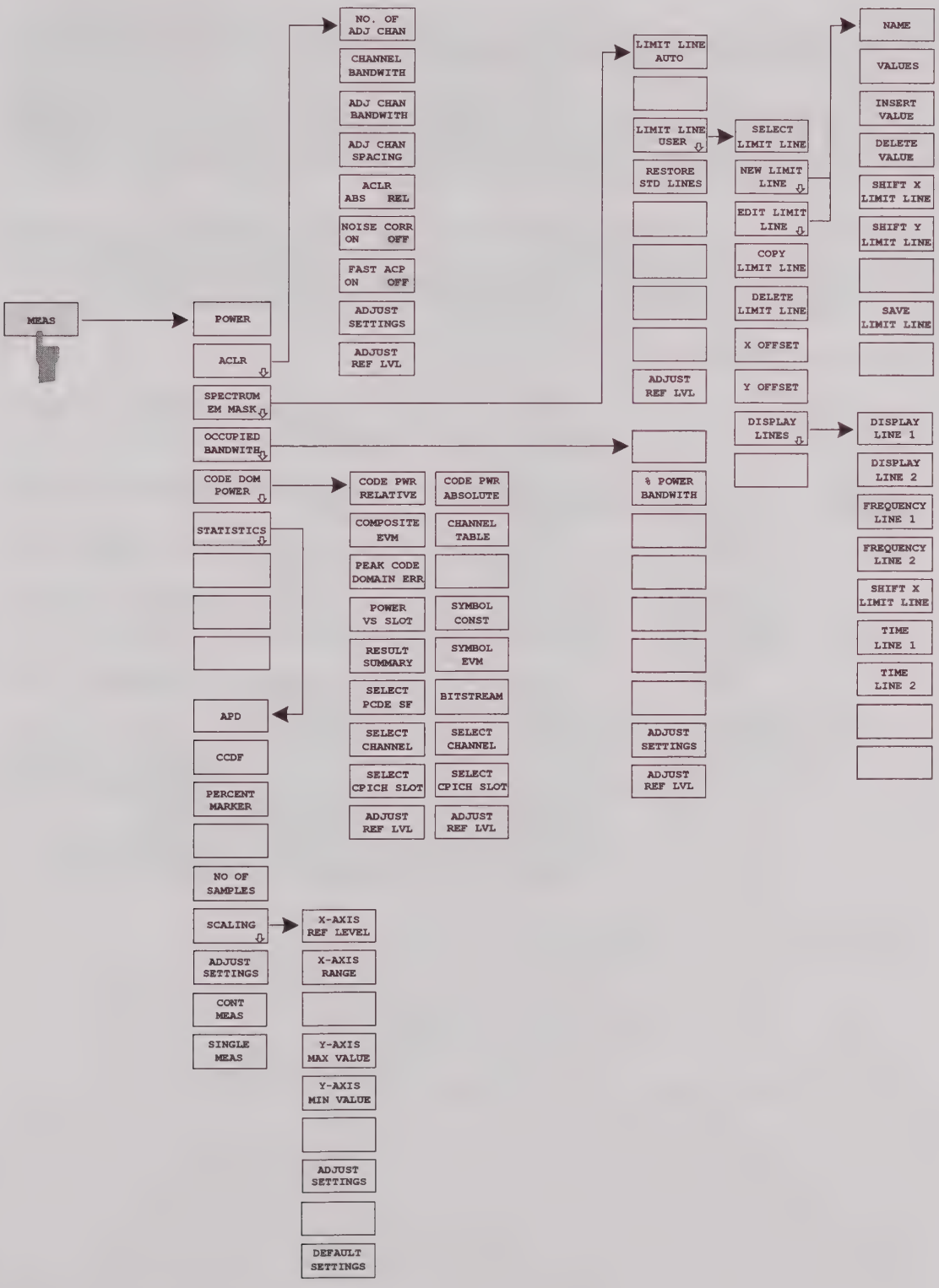


Fig. 5-2 Overview of menus - measurements

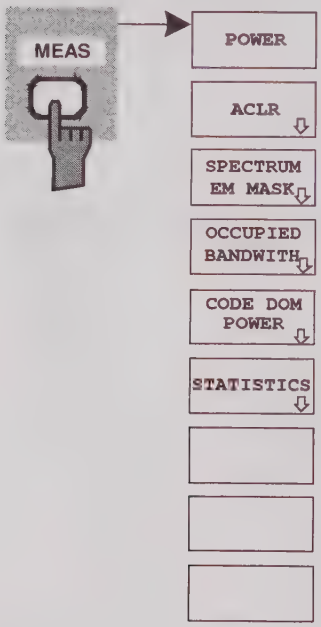
6 Configuration of 3GPP FDD Measurements

The most important parameters for the 3GPP FDD base station tests are summarized in the menu of key *MEAS* and are explained below using the softkey functions.

The *CODE DOM POWER* softkey activates the code domain measurement mode and opens the submenus for setting the measurement. A change of the hotkey labels after the application has been started ensures that the most important parameters of the CDP (code domain power) measurements are directly accessible via the hotkey bar.

The softkeys *POWER*, *ACLR*, *SPECTRUM EM MASK*, *OCCUPIED BANDWIDTH* and *STATISTICS* activate base station tests in the analyzer mode. Pressing the associated softkey performs the settings required by 3GPP specifications. A subsequent modification of settings is possible. The other menus of FSU correspond to the menus of this mode and are described in the operating manual of FSU.

CONFIGURATION MODE menu

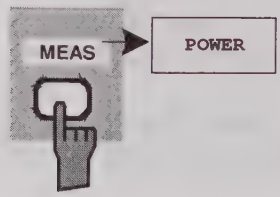


The *MEAS* key opens a submenu for setting the various measurement modes of option FS-K72:

- *POWER* activates the channel power measurement with defined settings in the analyzer mode.
- *ACLR* activates the adjacent channel power measurement with defined settings in the analyzer mode.
- *SPECTRUM EM MASK* compares the signal power in different carrier offset ranges with the maximum values specified by 3GPP.
- *OCCUPIED BANDWIDTH* activates the measurement of the occupied bandwidth (analyzer mode).
- *CODE DOM POWER* activates the code domain measurement mode and opens another submenu for selecting and configuring the parameters. All other menus of FSU are adapted to the functions of the code domain measurement mode.
- *STATISTICS* evaluates the signal with regard to its statistical characteristics (distribution function of the signal amplitudes).

Measurement of Channel Power

Key *MEAS*



The *POWER* softkey activates the measurement of the 3GPP FDD signal channel power.

FSU measures the RF signal power in the 3.84 MHz bandwidth. The power is calculated by summing up the values at the trace points. The individual trace points are weighted with the root raised cosine function as specified by the 3GPP standard. The bandwidth is displayed numerically below the screen.

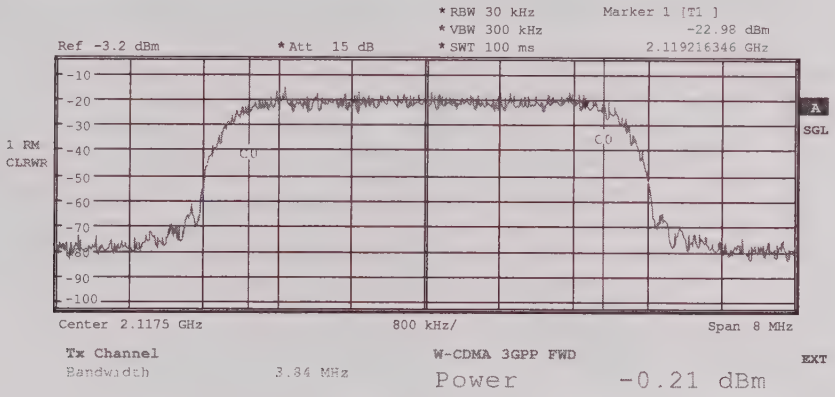


Fig. 6-1 Power measurement in the 3.84 MHz transmission channel

Pressing the softkey activates the analyzer mode with defined settings:

SYSTEM PRESET		
After PRESET the following user-specific settings are restored and so the adaptation to the DUT is maintained:	Reference Level , Reference Level Offset Center Frequency, Frequency Offset Input Attenuation, Mixer Level All trigger settings	
CHAN PWR / ACP	CP / ACP ON	
CP / ACP STANDARD	W-CDMA 3GPP FWD	
CP / ACP CONFIG	NO. OF ADJ CHAN	0

Starting from these settings, FSU can be operated in all functions available in the analyzer mode, i.e. all test parameters can be adapted to the requirements of the specific measurement.

IEC/IEEE-bus command:

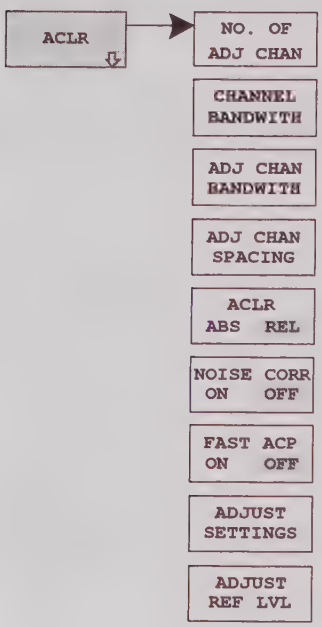
```
:CONFigure:WCDPower:MEASurement POWer
```

Query of results:

```
:CALCulate:MARKer:FUNCtion:POWer:RESult? CPOWer
```

Measurement of Adjacent-Channel Power - ACLR

Key *MEAS*



The *ACLR* softkey activates the adjacent-channel power measurement in the default setting according to 3GPP specifications (Adjacent Channel Leakage Power Ratio).

FSU measures the channel power and the relative power of adjacent channels and of the next channels. The results are displayed below the screen.

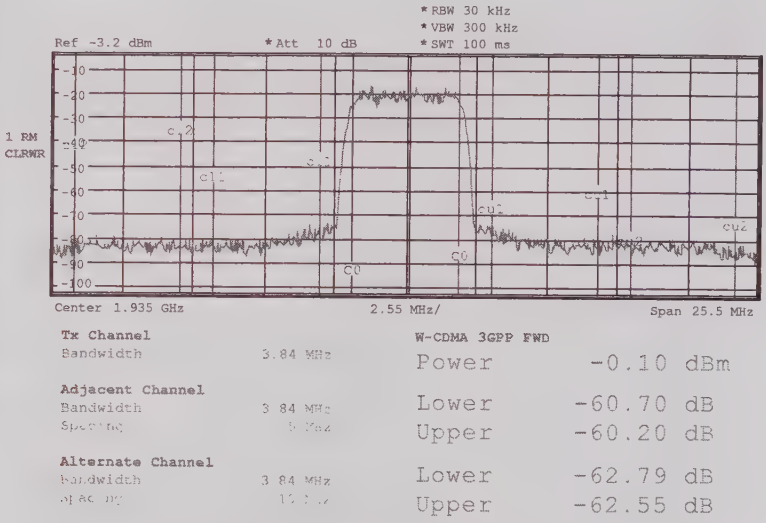


Fig. 6-2 Adjacent-channel power measurement of a 3GPP FDD base station.

Pressing the softkey activates the analyzer mode with defined settings:

SYSTEM PRESET		
After PRESET the following user-specific settings are restored and so the adaptation to the DUT is maintained:	Reference Level , Reference Level Offset Center Frequency, Frequency Offset Input Attenuation, Mixer Level All trigger settings	
CHAN PWR / ACP	CP / ACP ON	
CP / ACP STANDARD	W-CDMA 3GPP FWD	
CP / ACP CONFIG	NO. OF ADJ CHAN	2

Starting from these settings, FSU can be operated in all functions available in the analyzer mode, i.e. all test parameters can be adapted to the requirements of the specific measurement.

IEC/IEEE-bus command: `:CONFigure:WCDPower:MEASurement ALCR`

Query of results: `:CALCulate:MARKer:FUNCtion:POWer:RESult? ACPower`

The *NO. OF ADJ CHAN* softkey activates the entry of the number ±n of adjacent channels to be considered in the adjacent-channel power measurement.
Numbers from 0 to 3 can be entered.

The following measurements are performed depending on the number of the channels.

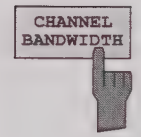
0 Only the channel power is measured.

1 The channel power and the power of the upper and lower adjacent channel are measured.

2 The channels power, the power of the upper and lower adjacent channel and of the next higher and lower channel (alternate channel 1) are measured.

3 The channel power, the power of the upper and lower adjacent channel, the power of the next higher and lower channel (alternate channel 1) and of the next but one higher and lower adjacent channel (alternate channel 2) are measured.

IEC/IEEE-bus command: `POW:ACH:ACP 1`



The *CHANNEL BANDWIDTH* softkey activates the entry of the channel bandwidth for the transmission channel.

The useful channel bandwidth is generally defined by the transmission method. In the WCDMA default setting, measurements are performed with a channel bandwidth of 3.84 MHz.

When measuring according to the IBW method (*FAST ACP OFF)* the channel bandwidth is displayed by two vertical lines to the left and right of the screen center. It can thus be visually checked whether the whole power of the signal to be measured is within the selected channel bandwidth.

With the time domain method (*FAST ACP ON)* the measurement is performed in zero span. The channel limits are not marked in this case. The FSU offers all available channel filters for selection of the channel bandwidth. Deviating channel bandwidths cannot be set. If deviating channel bandwidths are required, the IBW method should be used.

IEC/IEEE-bus command: `SENS:POW:ACH:BWID 3.84MHz`

The ADJ *CHAN BANDWIDTH* softkey opens a table for defining the channel bandwidths for the adjacent channels.

ACP CHANNEL BW	
CHAN	BANDWIDTH
ADJ	3.84 MHz
ALT1	3.84 MHz
ALT2	3.84 MHz

When measuring according to the IBW method (FAST ACP OFF) the bandwidths of the different adjacent channels are to be entered numerically. Since all adjacent channels often have the same bandwidth, the other channels ALT1 and ALT2 are set to the bandwidth of the adjacent channel on entering the adjacent-channel bandwidth (ADJ). Thus only one value needs to be entered in case of equal adjacent channel bandwidths. The same holds true for the ALT2 channels (alternate channels 2) when the bandwidth of the ALT1

channel (alternate channel 1) is entered.

Note: *The bandwidths can be selected independent from each other by overwriting the table from top to bottom.*

With the time domain method (FAST ACP ON), the adjacent-channel bandwidths are selected from the list of available channel filters. For deviating adjacent-channel bandwidths the IBW method should be used.

IEC-Bus-Befehl:
```
SENS:POW:ACH:BWID:ACH 3.84MHz
SENS:POW:ACH:BWID:ALT1 3.84MHz
SENS:POW:ACH:BWID:ALT2 3.84MHz
```

The ADJ *CHAN SPACING* softkey opens a table for defining the channel spacings.

ACP CHANNEL SPACING	
CHAN	SPACING
ADJ	5 MHz
ALT1	10 MHz
ALT2	15 MHz

Since all the adjacent channels often have the same distance to each other, the entry of the adjacent-channel spacing (ADJ) causes channel spacing ALT1 to be set to twice and channel spacing ALT2 to three times the adjacent-channel spacing. Thus only one value needs to be entered in case of equal channel spacing. The same holds true for the ALT2 channels when the bandwidth of the ALT1 channel is entered.

Note: *The channel spacings can be set separately by overwriting the table from top to bottom.*

IEC-Bus-Befehl:
```
SENS:POW:ACH:SPAC:ACH 5MHz
SENS:POW:ACH:SPAC:ALT1 10MHz
SENS:POW:ACH:SPAC:ALT2 15MHz
```

The *CP/ACP ABS/REL* softkey (channel power absolute/relative) switches between absolute and relative power measurement in the channel.

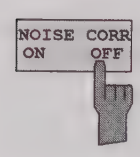
ACLR ABS The absolute power in the transmission channel and in the adjacent channels is displayed in the unit of the Y-axis, e.g. in dBm.

ACLR REL In case of adjacent-channel power measurement (*NO. OF ADJ CHAN* > 0) the level of the adjacent channels is displayed relative to the level of the transmission channel in dBc.

With linear scaling of the Y-axis, the power of the new channel relative to the reference channel (CP/CP_{ref}) is displayed. With dB scaling, the logarithmic ratio $10lg\ (CP/CP_{ref})$ is displayed.

The relative channel power measurement can thus also be used for universal adjacent-channel power measurements. Each channel can be measured individually.

IEC/IEEE-bus command: `SENS:POW:ACH:MODE ABS`



The *NOISE CORR ON/OFF* softkey switches on the correction of results by the inherent noise, thus increasing the dynamic range. On switching on the function a reference measurement of the inherent noise is first performed. The measured noise power is then substracted from the power of the examined channel.
For each modification of center frequency, resolution bandwidth, sweep time and level setting the inherent noise measuremnt is switched off. To repeat the reference measurement at the new setting, the softkey has to be pressed again.

IEC/IEEE-bus command: `SENS:POW:NCOR ON`

The *FAST ACP* softkey switches between the IBW method (*FAST ACP OFF*) and the time domain method (*FAST ACP ON*).

With *FAST ACP ON* the power measurement is performed in the different channels in time domain. The FSU sets the center frequency consecutively to the different channel center frequencies and measures the power with the selected measurement time (= sweep time/number of channels). The RBW filter suitable for the selected standard and frequency offset are automatically used (eg root raised cos with IS 136). The list of available channel filters is included in section "Setting of Bandwidths and Sweep Time – *BW key*".

The RMS detector is used for obtaining correct power measurement results. Therefore this requires no software correction factors.

The measured values are displayed in a table, the power in the useful channel being displayed in dBm and the power in the adjacent channels in dBm (CP/ACP ABS) or dB (CP/ACP REL).

The sweep time is selected depending on the desired reproducibility of results. Reproducibility increases with sweep time since power measurement is then performed over a longer time period.

As a general approach, it can be assumed that approx. 500 non-correlated measured values are required for a reproducibility of 0.5 dB (99% of the measurements are within 0.5 dB of the true measured value). This holds true for white noise. The measured values are considered as non-correlated when their time interval corresponds to the reciprocal of the measured bandwidth.

IEC/IEEE-bus command `SENS:POW:HSP ON`

The *ADJUST SETTINGS* softkey automatically optimizes the instrument settings for the selected power measurement (see below). All instrument settings relevant for a power measurement within a specific frequency range (channel bandwidth) are optimized for the selected channel configuration (channel bandwidth, channel spacing):

- Frequency span:

  The frequency span has to cover at least all channels to be considered.
  When measuring the channel power, span is set to 2 x channel bandwidth.
  The setting of the span during adjacent-channel power measurement is dependent on the channel spacing and channel bandwidth of the adjacent channel ADJ, ALT1 or ALT2 with the largest distance from the transmission channel.

- Resolution bandwidth RBW ≤ 1/40 of channel bandwidth
- Video bandwidth VBW ≥ 3 × RBW
- Detector RMS detector

Trace math and trace averaging functions are switched off.
The reference level is not influenced by *ADJUST SETTINGS*. It can be separately adjusted with *ADJUST REF LVL*.

The adjustment is carried out only once; if necessary, the instrument settings can be changed later.

IEC/IEEE-bus command:

```
SENS:POW:ACH:PRES ACP|CPOW|OBW
```

The *ADJUST REF LVL* softkey adjusts the reference level of the FSU to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the FSU or limiting the dynamic range by a too small S/N ratio.
Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is still significantly below the reference level.

IEC/IEEE-bus command: `SENS:POW:ACH:PRES:RLEV`

For manual setting of the test parameters different from the settings made with *ADJUST SETTINGS* the following should be observed:

Frequency span

The frequency span has to cover at least all channels to be measured.
For channel power measurement this is the channel bandwidth.
If the frequency span is large compared to the frequency section (or frequency sections) under test, only a few pixels are available to be measured.

Resolution bandwidth (RBW)

To ensure both an acceptable measurement speed and the required selection (to suppress spectral components outside the channel to be measured, especially of the adjacent channels), the resolution bandwidth must not be selected too small or too large. As a general approach, the resolution bandwidth is to be set to values between 1% and 4% of the channel bandwidth. A larger resolution bandwidth can be selected if the spectrum within the channel to be measured and around it has a flat characteristic.

Video bandwidth (VBW)

For a correct power measurement, the video signal must not be limited in bandwidth. A restricted bandwidth of the logarithmic video signal would cause signal averaging and thus result in a too low indication of the power (-2.51 dB at very low video bandwidths). The video bandwidth should therefore be selected at least three times the resolution bandwidth.

The *ADJUST SETTINGS* softkey sets the video bandwidth (VBW) as a function of the channel bandwidth as follows:

$VBW \geq 3 \times RBW$.

Detector

The *ADJUST SETTINGS* softkey selects the RMS detector.
The RMS detector is selected since it correctly indicates the power irrespective of the characteristics of the signal to be measured. In principle, the sample detector would be possible as well. Due to the limited number of trace pixels used to calculate the power in the channel, the sample detector would yield less stable results. Averaging, which is often performed to stabilize the measurement results, leads to a too low-level indication and should therefore be avoided. The reduction in the displayed power depends on the number of averages and the signal characteristics in the channel to be measured.

Signal Power Check – SPECTRUM EM MASK

Key *MEAS*

SPECTRUM EM MASK → LIMIT LINE AUTO

LIMIT LINE MANUAL

LIMIT LINE USER

RESTORE STD LINES

ADJUST REF LVL

The *SPECTRUM EM MASK* softkey starts the determination of the power of the 3GPP FDD signal in defined offsets from the carrier and compares the power values with a spectral mask specified by 3GPP.

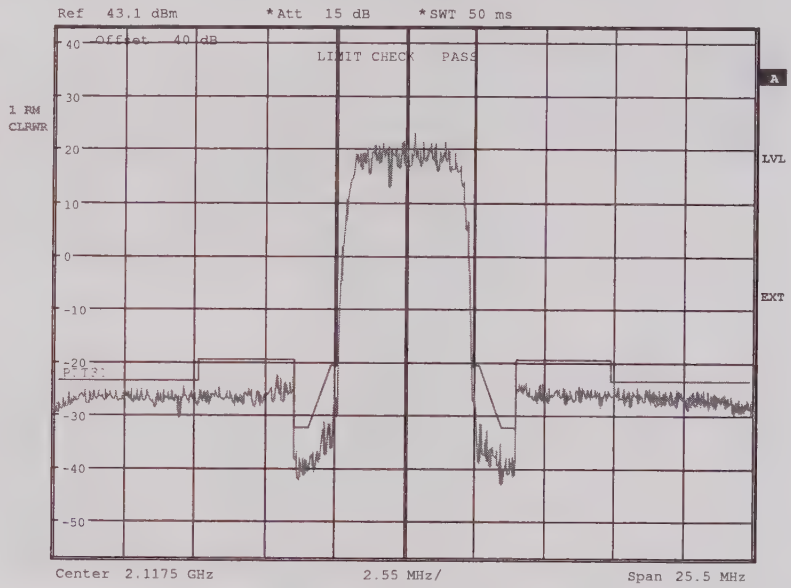


Fig. 6-3 Measurement of Spectrum Emission Mask.

Pressing the softkey activates the analyzer mode with defined settings:

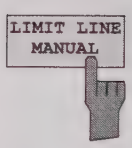
SYSTEM PRESET		
After PRESET the following user-specific settings are restored and so the adaptation to the DUT is maintained: Reference Level , Reference Level Offset Center Frequency, Frequency Offset Input Attenuation, Mixer Level All trigger settings		
CHAN PWR / ACP	CP / ACP ON	
CP / ACP STANDARD	W-CDMA 3GPP REV	
CP / ACP CONFIG	NO. OF ADJ CHAN	0
SPAN		25.5 MHz
BW	SWEEP TIME MANUAL	50 ms

IEC/IEEE-bus command: `:CONFigure:WCDPower:MEASurement ESPectrum`

Query of results: `:CALCulate:LIMit:FAIL?` and visual evaluation

The *LIMIT LINE AUTO* softkey automatically selects the limit line to be checked according to power determined in the useful channel. If the measurement is carried out in *CONTINUOUS SWEEP* and the channel power changes from sweep to sweep, this can result in the limit line being continuously redrawn.
The softkey is activated when the spectrum emission mask measurement is entered.

IEC/IEEE-bus command: `:CALC:LIM:ESP:MODE AUTO`



The *LIMIT LINE MANUAL* softkey activates the manual selection of a predefined limit line. If this softkey is selected, the channel power measurement is not used to select the limit line, but only to determine its relative components. The power at the different frequency offsets is compared with the user-defined limit line.

The softkey opens a table with all the limit lines predefined in the device:

P >= 43 dBm
39 dBm <= P < 43 dBm
31 dBm <= P < 39 dBm
P < 31 dBm

The name of the limit line indicates the expected power range, for which the limit line has been defined.

IEC/IEEE-bus command:
`:CALC:LIM:ESP:MODE MANual`
`:CALC:LIM:ESP:VALue 39`

The *LIMIT LINE USER* softkey activates the input of user-defined limit lines. The softkey opens the menus of the limit line editor that are known from the basic unit.
In contrast to the predefined limit lines supplied with the FSU which correspond to the standard specifications, the user-defined limit line can be specified for the entire frequency range (±12.5 MHz from carrier) either relatively (referred to the channel power) or absolutely.

IEC/IEEE-bus command: see Table of Softkeys with Assignment of IEC/IEEE Commands

The *RESTORE STD LINES* softkey restores the limit lines defined in the standard to the state they were in when the unit was delivered. This prevents inadvertent overwriting of the standard lines.

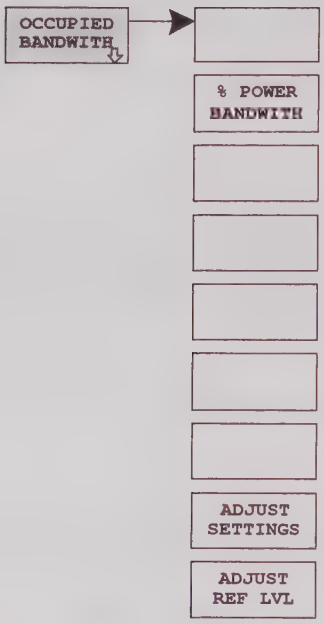
IEC/IEEE-bus command: `:CALC:LIM:ESP:RESTore`

The *ADJUST REF LVL* softkey adjusts the FSU reference level to the total signal power measured.
The softkey becomes active after the first sweep has been terminated with the measurement of the occupied bandwidth and the total signal power is known.
The adjustment of the reference level ensures that the FSU signal path is not overdriven and that the dynamic range is not limited by a reference level that is too low.

IEC/IEEE-bus command: `SENS:POW:ACH:PRES:RLEV`

Measurement of Occupied Bandwidth - OCCUPIED BANDWIDTH

Key *MEAS*



The *OCCUPIED BANDWIDTH* activates the measurement of the bandwidth, which the signal occupies.

The occupied bandwidth is defined as the bandwidth that – in default settings – 99% of the total signal power are to be found in. The percentage of the signal power to be included in the bandwidth measurement can be changed.
The occupied bandwidth and the frequency markers are output in the marker info field at the top right edge of the screen.

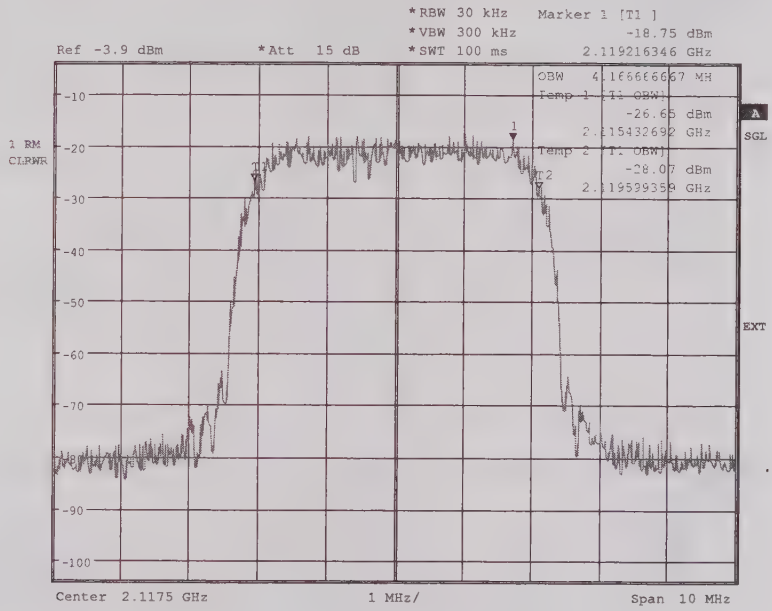


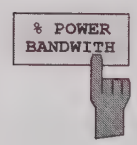
Fig. 6-4 Measurement of occupied bandwidth.

Pressing the softkey activates the analyzer mode with defined settings:

SYSTEM PRESET		
After PRESET the following user-specific settings are restored and so the adaptation to the DUT is maintained: Reference Level , Reference Level Offset Center Frequency, Frequency Offset Input Attenuation, Mixer Level All trigger settings		
OCCUPIED BANDWITH		
TRACE 1	DETECTOR	RMS

IEC/IEEE-bus command: `:CONFigure:WCDPower:MEASurement OBANdwidth`

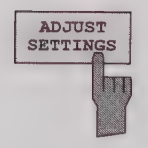
Query of results: `:CALCulate:MARKer:FUNCtion:POWer:RESult? OBANdwidth`



The *% POWER BANDWIDTH* softkey opens the entry of the percentage of power related to the total power in the displayed frequency range which defines the occupied bandwidth (percentage of total power).
The valid range of values is 10% to 99.9%.

IEC/IEEE-bus command:

```
SENS:POW:BWID 99PCT
```



The *ADJUST SETTINGS* softkey automatically optimizes the instrument settings for the selected power measurement (see below).
All instrument settings relevant for a power measurement within a specific frequency range (channel bandwidth) are optimized for the selected channel configuration (channel bandwidth, channel spacing):

- Frequency span:

  The frequency span has to cover at least all channels to be considered.
  When measuring the channel power, 2 x channel bandwidth is set as span.
  The setting of the span during adjacent-channel power measurement is dependent on the channel spacing and channel bandwidth of the adjacent channel ADJ, ALT1 or ALT2 with the largest distance from the transmission channel.

- Resolution bandwidth RBW $\leq$ 1/40 of channel bandwidth
- Video bandwidth VBW $\geq 3 \times$ RBW
- Detector RMS detector

Trace math and trace averaging functions are switched off.
The reference level is not influenced by *ADJUST SETTINGS*. It can be separately adjusted with *ADJUST REF LVL*.

The adjustment is carried out only once; if necessary, the instrument settings can be changed later.

IEC/IEEE-bus command:

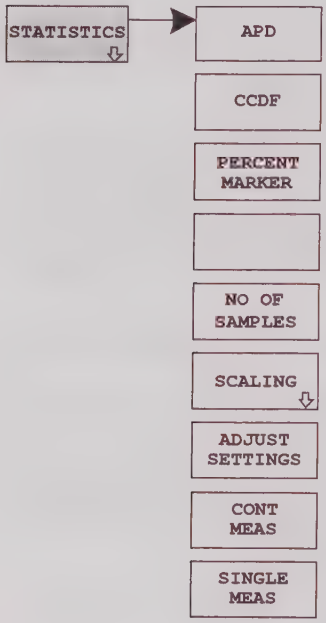
```
SENS:POW:ACH:PRES OBW
```

The *ADJUST REF LVL* softkey adjusts the reference level of the analyzer to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the instrument or limiting the dynamic range by a too small S/N ratio.
Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is still significantly below the reference level.

IEC/IEEE-bus command: `SENS:POW:ACH:PRES:RLEV`

Signal Statistics

Key *MEAS*



The *STATISTICS* softkey starts a measurement of the distribution function of the signal amplitudes (complementary cumulative distribution function). The measurement can be switched to amplitude power distribution (APD) by means of the menu softkeys.

For the purposes of this measurement, a signal section of settable length is recorded continuously in the zero span, and the distribution of the signal amplitudes is evaluated. The record length and display range of the CCDF can be set using the softkeys of the menu. The amplitude distribution is displayed logarithmically as a percentage of the amount by which a particular level is exceeded, beginning with the average value of the signal amplitudes.

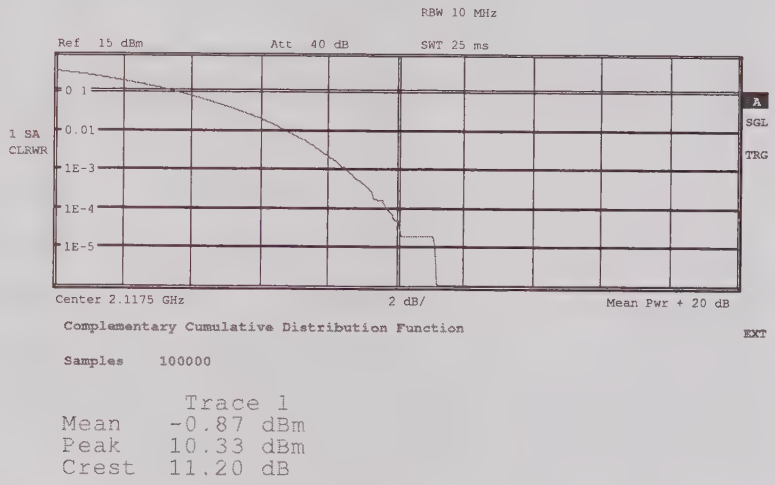


Fig. 6-5 CCDF of a 3GPP FDD signal.

Pressing the softkey activates the analyzer mode with defined settings:

SYSTEM PRESET		
After PRESET the following user-specific settings are restored and so the adaptation to the DUT is maintained:	Reference Level , Reference Level Offset Center Frequency, Frequency Offset Input Attenuation, Mixer Level All trigger settings	
SIGNAL STATISTIC		
TRACE1	DETECTOR	SAMPLE
BW	RES BW MANUAL	10 MHz
	VIDEO BW MANUAL	5 MHz

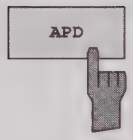
Starting from these settings, FSU can be operated in all functions available in the analyzer mode, i.e. all test parameters can be adapted to the requirements of the specific measurement.

IEC/IEEE-bus command:

```
:CONFigure:WCDPower:MEASurement CCDF
```
or
```
:CALCulate:STATistics:CCDF ON
```

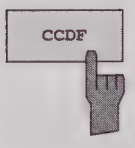
Query of results:

```
:CALCulate:MARKer:X?
```



The *APD ON/OFF* softkey switches on the amplitude probability distribution function.
When the APD function is switched on, the CCDF function is switched off automatically.

IEC/IEEE-bus command: `CALC:STAT:APD ON`



The *CCDF ON/OFF* softkey switches on the complementary cumulative distribution function.
When the CCDF function is switched on, the APD function is switched off automatically.

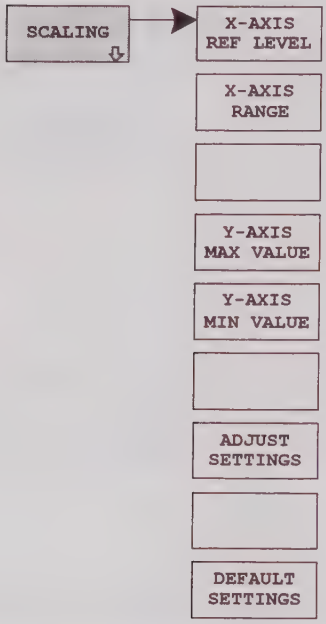
IEC/IEEE-bus command: `CALC:STAT:CCDF ON`

If the CCDF function is active, the *PERCENT MARKER* softkey allows to position marker 1 by entering a probability value. Thus, the power that is exceeded with a given probability can be determined very easily.
If marker 1 is in the switched-off state, it will be switched on automatically.

IEC/IEEE-bus command: `CALC:MARK:Y:PERC 0...100%`

NO OF SAMPLES softkey sets the number of power measurements taken into account for the statistics.
Please note that the overall measurement time is influenced by the number of samples selected as well as by the resolution bandwidth set up for the measurement as the resolution bandwidth directly influences the sampling rate.

IEC/IEEE-bus command: `CALC:STAT:NSAM <value>`



The *SCALING* softkey opens a sub menu that allows changing the scaling parameters for both the x- and the y-axis.

The *X-AXIS REF LEVEL* softkey changes the level settings of the instrument and sets the maximum power to be measured.
The function is identical to softkey *REF LEVEL* in menu *AMPT*.
For the *APD* function this value is mapped to the right diagram border.
For the *CCDF* function there is no direct representation of this value on the diagram as the x-axis is scaled relatively to the *MEAN POWER* measured.

IEC/IEEE command: `CALC:STAT:SCAL:X:RLEV <value>`

The *X-AXIS RANGE* softkey changes the level range to be covered by the statistics measurement selected.
The function is identical to softkey *RANGE LOG MANUAL* in menu *AMPT*.

IEC/IEEE command: `CALC:STAT:SCAL:X:RANG <value>`

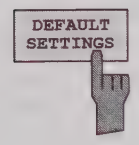
The *Y-AXIS MAX VALUE* softkey defines the upper limit of the displayed probability range.
Values on the y-axis are normalized which means that the maximum value is 1.0. As the y-axis scaling has a logarithmic axis the distance between max and min value must be at least one decade.

IEC/IEEE command: `CALC:STAT:SCAL:Y:UPP <value>`

The *Y-AXIS MIN VALUE* softkey defines the lower limit of the displayed probability range.
As the y-axis scaling has a logarithmic axis the distance between max and min value must be at least one decade. Valid values are in the range 0 < value < 1.

IEC/IEEE command: `CALC:STAT:SCAL:Y:LOW <value>`

See below



The *DEFAULT SETTINGS* softkey resets the x- and y-axis scalings to their PRESET values.

x-axis reference level: -20 dBm
x-axis range APD: 100 dB
x-axis range CCDF: 20 dB

y-axis upper limit: 1.0
y-axis lower limit: 1E-6

IEC/IEEE-bus command: `CALC:STAT:PRES`

The *ADJUST SETTINGS* softkey optimizes the level settings of the FSU according to the measured peak power in order to gain maximum sensitivity of the instrument.
The level range is adjusted according to the measured difference between peak and minimum power for APD measurement and peak and mean power for CCDF measurement in order to obtain maximum power resolution.
Additionally the probability scale is adapted to the selected number of samples.

IEC/IEEE-bus command: `CALC:STAT:SCAL:AUTO ONCE`

The *CONT MEAS* softkey starts collecting a new sequence of sample data and calculating the APD or CCDF curve depending on the selected measurement. The next measurement is started automatically as soon as the indicated number of samples has been reached ("CONTinuous MEASurement").

IEC/IEEE-bus command:
```
INIT:CONT ON;
INIT:IMM
```

The *SINGLE MEAS* softkey starts collecting a new sequence of sample data and calculating the APD or CCDF curve depending on the selected measurement. At the beginning of the measurement previously obtained measurement results are discarded.

IEC/IEEE-bus command:
```
INIT:CONT OFF;
INIT:IMM
```

Code Domain Measurements on 3GPP FDD Signals

Application Firmware FS-K72 provides the peak code domain error measurement and an EVM measurement of the total signal (composite EVM), prescribed by the 3GPP standard as well as the code domain power measurement of assigned and unassigned codes. In addition, the symbols demodulated in a slot, the decided bits or the symbol EVM can be displayed for an active channel.

A signal section of approx. 20 ms is recorded for analysis and searched for the start of a 3GPP FDD frame. If a frame start is found in the signal, the CDP analysis is performed for a complete frame starting from slot 0.

Application firmware FS-K72 offers two different ways of representing the code domain power measurement:

- Representation of all code channels

  Option FS-K72 displays the power of all occupied code channels in a bargraph. The X-axis is scaled for the highest code class or the highest spreading factor (512). Code channels with a lower spreading factor occupy correspondingly more channels of the highest code class. The power of a code channel is always measured according to its symbol rate. Unused code channels are assumed to belong to the highest code class and displayed accordingly. The displayed power of an unused code channel therefore corresponds to the power of a channel with the spreading factor 512 at the respective code position.
  To simplify identification, used and unused channels are displayed in different colours. Used channels are yellow, unused channels are blue.
  The measured power always refers to one slot. The time reference for the start of a slot is the CIPCH slot. If the signal contains channels with timing offsets the start of a slot of the channel may be different from the CPICH slot start. This leads to the power of the bargraphs normally being averaged over two adjacent slots in such cases. The power shown in the bargraphs thus not necessarily corresponds to the slot power of the channel the bargraph belongs to. If channels with a timing offset contain a power control circuit, the channel-power-versus-time display (slot spacing, see *POWER VS SLOT*) should preferably be used for power measurements (power control).

- Representation of channel power versus slots of a 3GPP FDD signal frame

  In this case the power of a selectable code channel is indicated versus a frame. The power is always measured within one slot (PCG) of the selected channel. Power control is assumed to take time at the start of the pilot symbols of the previous slots.
  If code channels contain a timing offset, the start of a specific slot of the channel differs from the start of the reference channel (CPICH). Timing offsets, counted from the startinmg of a 3GPP FDD frame, can be as long as one complete frame. The display shows the relationship: The grid of the power vs. slot diagram represents the CPICH slots. The bargraphs, containing the slot power information, are drawn shifted by the timing offset. Thus, the timing offset of the channels can directly be read from the diagram.

For all measurements performed in a slot of a selected channel (bits, symbols, EVM), the actual slot spacing of the channel is taken as a basis.

The composite EVM and peak code domain error measurements are always referred to the total signal.

For code domain power (CDP) measurements, the display is operated in the *SPLIT SCREEN* mode. Only those display modes showing the code domain power of all channels (*CODE PWR RELATIVE*, *CODE PWR ABSOLUTE*, *CHANNEL TABLE*) are permitted in the upper part of the screen, all other display modes are assigned to the lower part of the screen.

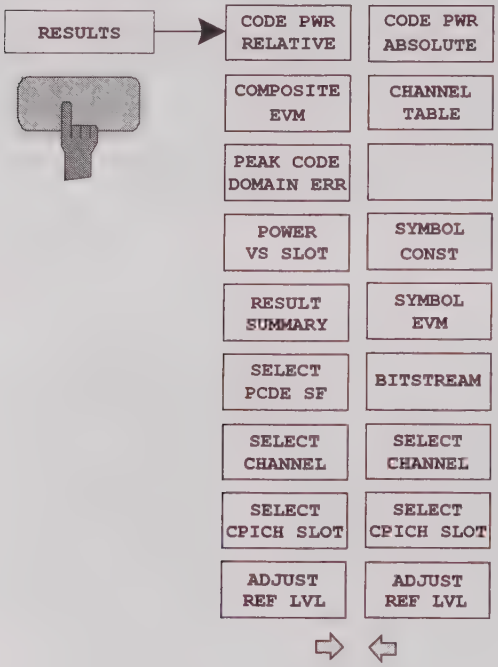
FS-K72 expects the following synchronization channels for the code domain power measurements.

- Common pilot channel (CPICH),
- Primary common control physical channel (PCCPCH),
- Primary synchronization channel (PSCH),
- Secondary synchronization channel (SSCH).

There are two modes for the CDP analysis. In the *CODE CHAN AUTOSEARCH* mode, FS-K72 performs an automatic search for active channels in the whole code domain. The search is based on the presence of known symbol sequences (pilot sequences) in the despread symbols of a channel. Channels without or with incomplete pilot sequences cannot be detected as being active in this mode. In the *AUTOSEARCH* mode, only the special channel PICH can be detected as active, even though it does not contain pilot symbols. In the *CODE CHAN PREDEFINED* mode, the user can define the active channels contained in the signal via tables that can be selected and edited. For these channels a channel search by comparison with pilot sequences is no longer performed. In this mode, special channels without pilot sequences (which should be in the code domain however) can therefore be taken into account by FS-K72 for the CDP analysis.

Display Mode – *RESULTS* hotkey

Hotkey *RESULTS*



The *RESULTS* hotkey opens a submenu for setting the display mode. The main menu contains the most important display modes as well as the measurements specified by the 3GPP standard for a fast access, whereas the side menu contains more detailed display modes.

The following display modes are available:

CODE PWR RELATIVE
: Code domain power with relative scaling

COMPOSITE EVM
: Square difference between test signal and ideal reference signal

PEAK CODE DOMAIN ERR
: Projection of the error between the test signal and the ideal reference signal onto the various spreading factors and subsequent summation using the symbols of each slot of the difference signal

POWER VS SLOT
: Power of the selected channel versus all slots of a 3GPP FDD signal frame

RESULT SUMMARY
: Tabular result display

CODE PWR ABSOLUTE
: Code domain power with absolute scaling

CHANNEL TABLE
: Display of channel occupation table

SYMBOL CONST
: Display of constellation diagram

SYMBOL EVM
: Display of error vector magnitude diagram

BITSTREAM
: Display of decided bits

By entering a channel number (*SELCT CHANNEL* softkey) in the modes *CODE PWR RELATIVE /ABSOLUTE* it is possible to mark a channel for more detailed display modes (*SYMBOL CONST*, *SYMBOL EVM* and *BITSTREAM*).

In the *POWER VS SLOT*, *COMPOSITE EVM* and *PEAK CODE DOMAIN ERR* display modes a slot can be marked by entering a slot number using the *SELECT CPICH SLOT* softkey.

By *ADJUST REF LVL* an optimal fitting of the reference level to the signal level can be achieved.

Above the diagram, the most important measurement settings, which form the basis of the display modes, are summarized:

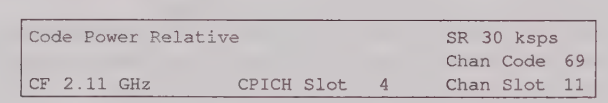


Fig. 6-6 Indication of measurement parameters

The different elements are:
1st column:

Code Power Relative:	Name of selected display mode
{empty}	
CF 2.11 GHz:	Center frequency of signal

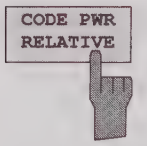
2nd column:

{empty}	
{empty}	
CPICH Slot 4:	CPICH slot number (value of SELECT CPICH SLOT softkey)

3rd column:

SR 30 ksps:	Symbol rate of selected channel
Chan Code 69:	Spreading code of selected channel
Chan Slot 11:	Slot number of selected channel

Note: *For the peak code domain error display mode, the indication of the symbol rate is replaced by the indication of the spreading factor onto which the error is projected (see PEAK CODE DOMAIN ERR softkey)*



The *CODE PWR RELATIVE* softkey selects the code domain power display mode with relative scaling.

In default mode, the power of the channels is referred to the CPICH power (code No. 0). This power reference was selected since the total power may vary depending on the slot due to the possibility of controlling the power in the different code channels. In contrast to the variable total power, the power of the CPICH is the same in all slots so that it can form the constant reference for the display. The reference can be switched to total power selecting setting *TOT* for the *POWER REF* softkey.

The measurement interval for determining the power of the channels is a slot in the CPICH (corresponding to a timing offset of 0 chip referred to the beginning of the signal frame).

The powers of the active channels and of the unassigned codes are shown in different colours:

- yellow: active channels
- blue: unassigned codes

In *CODE CHAN AUTOSEARCH* (automatic channel search mode) mode, a data channel is considered to be active if the pilot symbols as specified by standard 3GPP are to be found at the end of each slot. In addition, the channel must exceed a minimum power (see INACT CHAN THRESHOLD softkey). An exception to this rule is the special channel PICH which can be recognized as active in the automatic search mode although it does not contain pilot symbols.
In *CODE CHAN PREDEFINED* mode, each data channel that is included in the user defined channel table is considered to be active.

By entering a channel number (see *SELECT CHANNEL* softkey) it is possible to mark a channel for more detailed display modes. The marked channel is shown in red. The whole channel is marked if it is an assigned channel, and only the entered code is marked in the case of an unassigned code.
Selecting other display modes (e.g. SYMBOL CONSTELLATION) for unassigned codes is possible but not useful since the results are not valid.

In the CDP diagram, the effect of missing or incomplete pilot symbols in a data channel can be shown in analyzer mode *CODE CHANNEL AUTOSEARCH*. At the points of the CDP diagram where the channel should appear due to its spreading code, there is a power value higher than the noise. The associated bars, however, are displayed in blue. In such a case, the channel should be checked for its pilot symbols. In *CODE CHANNEL PREDEFINED* mode, the channel should be included in the user defined channel table.

The figures show how the CDP is displayed when all active channels contained in the signal have been found and when one of the channels has been recognized as inactive, e.g. because of missing pilot symbols.

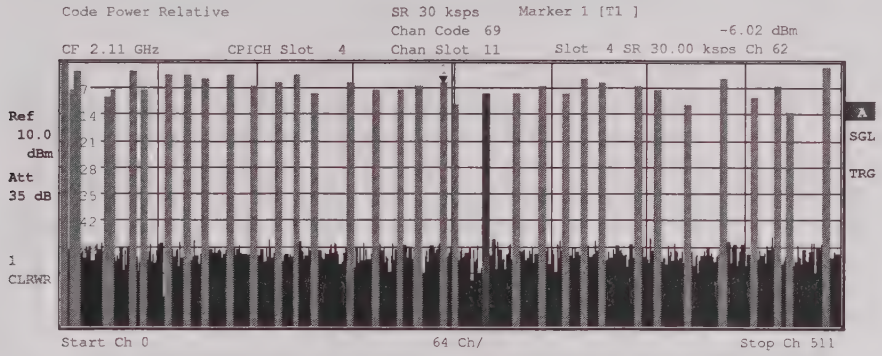


Fig. 6-7 CDP diagram with all channels recognized as active

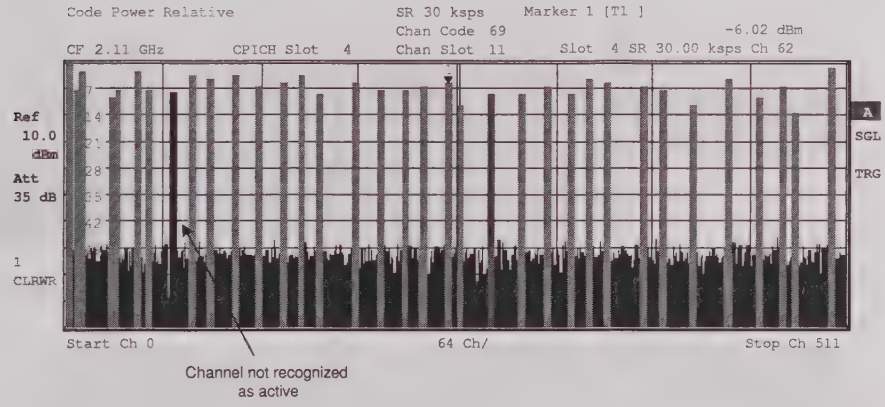


Fig. 6-8 CDP diagram with one of the channels recognized as inactive

IEC/IEEE-bus command: `:CALCulate<1>:FEED "XPOW:CDP:RAT"`

The *CODE PWR ABSOLUTE* softkey selects the code domain power display mode with absolute scaling.

The powers of the active channels and of the unassigned codes are shown in different colours:

- yellow: active channels
- blue: unassigned codes

After entering a code number (*SELECT CODE NO* softkey) it is possible to mark a channel for other display modes. The marked channel is shown in red.

The measurement interval for determining the power of the channels is a slot of the CPICH (corresponding to a timing offset of 0 chips referred to the beginning of the signal frame).

For the recognition of the active code channels, the conditions are the same as those described for *CODE PWR RELATIVE*.

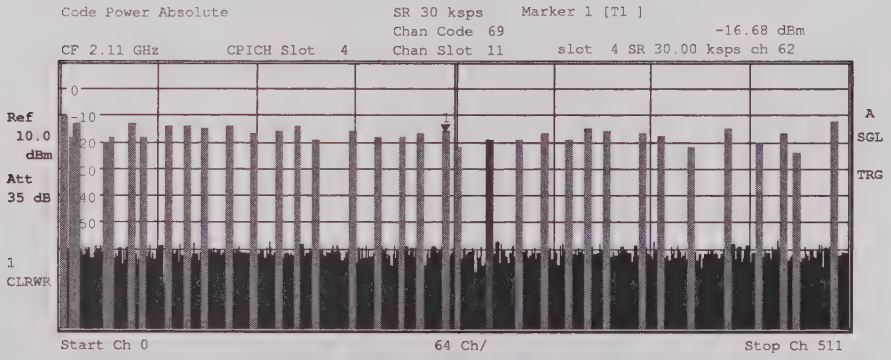


Fig. 6-9 Code domain power display mode with absolute scaling

IEC/IEEE-bus command: `:CALCulate<1>:FEED "XPOW:CDP"`

The *COMPOSITE EVM* softkey selects the composite EVM (modulation accuracy) display mode according to 3GPP specification.

During the composite EVM measurement, the square root of the squared errors between the real and imaginary parts of the test signal and an ideal reference signal (EVM referred to the total signal) is determined Composite EVM thus is a measurement of the composite signal.

The measurement result consists of one composite EVM measurement value per slot. In this case, the measurement interval is the slot spacing of the CPICH (timing offset of 0 chips referred to the beginning of the frame).

Only the channels recognized as active are used to generate the ideal reference signal. If an assigned channel is not recognized as active since pilot symbols are missing or incomplete, the difference between the measurement and reference signal, and the composite EVM is very high (see figures).

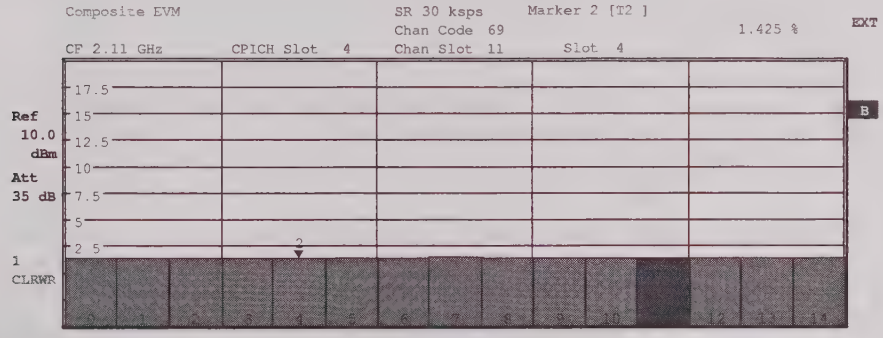


Fig. 6-10 Composite EVM - all channels are recognized as active

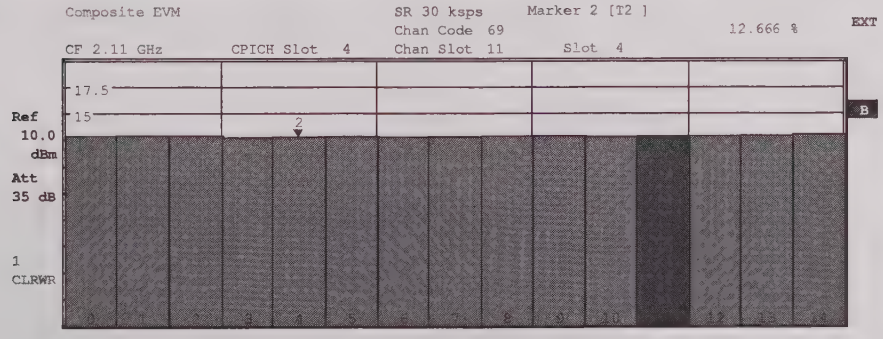


Fig. 6-11 Composite EVM - one channel is recognized as inactive

IEC/IEEE-bus command: `:CALCulate2:FEED "XTIM:CDP:MACCuracy"`

The *PEAK CODE DOMAIN ERR* softkey selects the peak code domain error display mode.

In line with the 3GPP specifications, the error between the measurement signal and the ideal reference signal is projected onto the various spreading factors. The desired spreading factor is selected by a table which is opened when the softkey is activated.

The result consists of a numerical value per slot for the peak code domain error value. The measurement interval is the slot spacing of the CPICH (timing offset of 0 chip referred to the beginning of the frame).

Only the channels recognized as active are used to generate the ideal reference signal for the peak code domain error. If an assigned channel is not recognized as active since pilot symbols are missing or incomplete, the difference between the measurement and reference signal is very high. FS-K72 consequently indicates a peak code domain error that is too high (see figures).

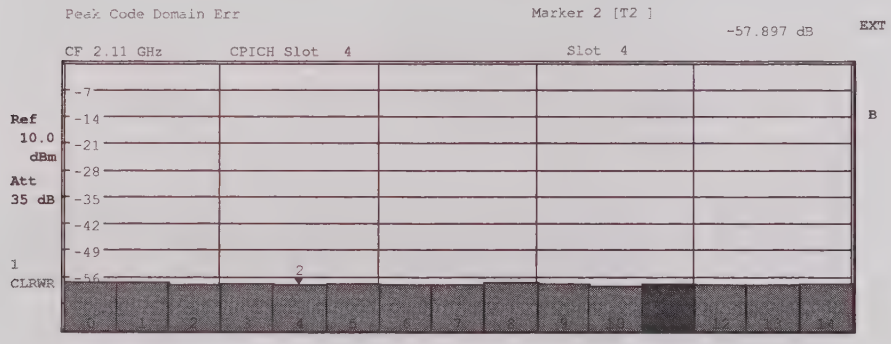


Fig. 6-12 Peak Domain Error - all channels are recognized as active

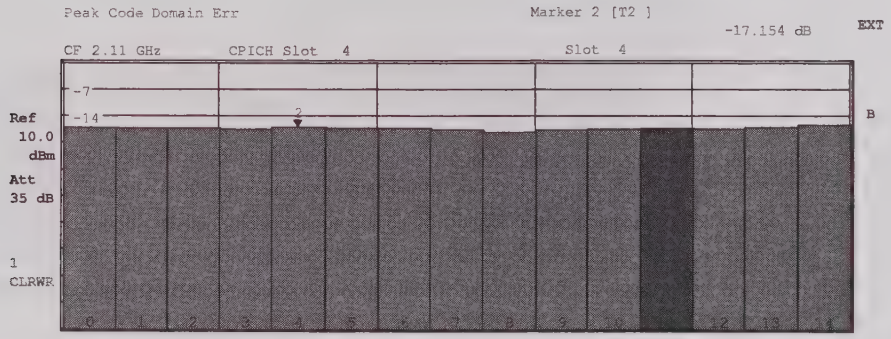
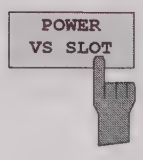


Fig. 6-13 Peak Domain Error - one channel is not recognized as active

IEC/IEEE-bus command: `:CALCulate2:FEED "XTIM:CDP:ERR:PCDomain"`



The *POWER VS SLOT* softkey selects the indication of the power of the selected code channel depending on the slot number. The power of the selected channel (marked red in the CDP diagram) is displayed versus all slots of a frame of the 3GPP FDD signal.

15 slots of a WCDMA frame are displayed. When the power is averaged versus the symbols of a slot, the time of the power control is assumed to be at the beginning of the pilot symbols of the previous slot (power group).
The following has to be taken into account: Due to the timing offset (up to one frame) admissible for the channels, the beginning of slot 0 of the selected channel is shifted with reference to the start of the frame (reference: CPICH slot 0). The timing offset therefore has also to be applied to the power-versus-slot display. To show the connection between timing offset and CDP analysis in the diagram, the X-axis reflects the slot spacing of the channel as well as of the CPICH.

- The grid of the power-versus-slot display reflects the spacing of the CPICH slots. The slots are always labelled at the grid line where the slot in question begins (top labelling of x axis in diagram). The first CPICH slot is always slot 0. The grid and the labels of the grid lines thus do not change.
- Shifted by the timing offset, the power versus channel slots is entered in a bargraph. The slot numbers of the channel are labeled within the bar associated with the slot. The position of the bars in relation to the grid and the slot numbering within the bar vary as a function of the timing offset of the channel selected.

The following figure shows a channel with power control (power decrease of 2 dB for each slot). For the channel has a timing offset (22528 chips), the display does not start with slot 0 of the channel but shifted by the timing offset. The red marked slot is the selected slot of CPICH. As shown in the display, the CPICH slot covers two neighbouring slots:

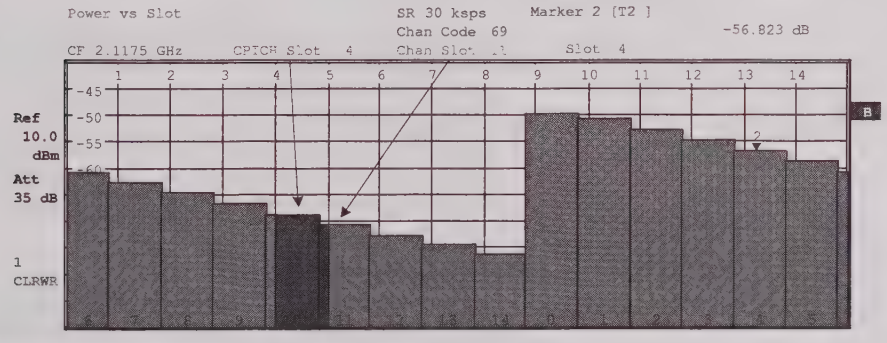


Fig. 6-14 Power versus Slot for a channel with power control (timing offset 22528 chips)

It is not only possible to select a code channel in the CDP diagram, but also to mark a slot in the power-versus-slot diagram. Marking is done by entering the CPICH slot number (see *SELECT CPICH SLOT* softkey) and the selected CPICH slot is marked in red. If the channel displayed has a timing offset against the CPICH, the marked slot is usually shifted against the slot raster of the channel, i.e. the red marking of a slot covers two of the bars below. The timing offset can be directly read from the shifting. For more detailed displays, the slot of the channel is selected which starts within the red slot marking (see CHAN SLOT entry in the function panels above the diagrams in the Figures).

Modifying a slot number has the following effects:

- The CDP diagram in the upper half of the display is updated referred to the entered CPICH slot number.

- Starting from the CPICH slot, all dependent results are calculated for the actual slot of the selected channel. The relevant graphics are updated. The slot of the channel that starts within the CPICH slot displayed in red is considered marked.

IEC/IEEE-bus command: `:CALCulate2:FEED "XTIM:CDP:PVSLot"`

The *RESULT SUMMARY* softkey selects the numerical display of all results. The display is subdivided as follows:

Result Summary SR 30 ksps EXT
Chan Code 69
CF 2.11 GHz CPICH Slot 4 Chan Slot 11

Result Summary

	GLOBAL RESULTS				
Ref	Total Power	-0.68 dBm	Carrier Freq Error	28.80 mHz	B
10.0	Chip Rate Error	0.01 ppm	Trigger to Frame	60.42 ns	
dBm	IQ Offset	0.36 %	IQ Imbalance	0.07 %	
Att	Composite EVM	1.43 %	Pk CDE (15.0 ksps)	-59.44 dB	
35 dB	CPICH Slot No	4	No of Active Chan	36	
	CHANNEL RESULTS				
	Symbol Rate	30.00 ksps	Timing Offset	22528 Chips	
1	Channel Code	69	Channel Slot No	11	
CLRWR	No of Pilot Bits	8			
	Channel Power Rel	-8.98 dB	Channel Power Abs	-19.64 dBm	
	Symbol EVM	1.23 % rms	Symbol EVM	2.16 % Pk	

Fig. 6-15 Result Summary

The upper part contains the results relating to the total signal:

Total Power: Outputs the total signal power (average power of total evaluated 3GPP FDD frame).

Carrier Freq Error:
Outputs the frequency error referred to the center frequency of the analyzer. The absolute frequency error is the sum of the analyzer and DUT frequency error.
Differences of more than 1 kHz between transmitter and receiver frequency impair the synchronization of the CDP measurement. For this reason, the transmitter and receiver should be synchronized (see chapter Getting Started).

Chip Rate Error:
Outputs the chip rate error in ppm
As a result of a high chip rate error symbol errors arise and the CDP measurement is possibly not synchronized to the 3GPP FDD signal. The result is valid even if the synchronization of analyzer and signal failed.

Trigger to Frame:
This result outputs the time difference between the beginning of the recorded signal section to the start of the analyzed 3GPP FDD frame. In the case of triggered data collection, this difference is identical with the time difference of frame trigger (+ trigger offset) – frame start. In the case of failure of the synchronization of analyzer and W-CDMA signal, the value of Trigger to Frame is not significant.

IQ Offset: DC offset of signals in %

IQ Imbalance: IQ imbalance of signal in %

Composite EVM: The composite EVM is the difference between the test signal and the ideal reference signal (see *COMPOSITE EVM* softkey). The composite EVM value for the selected slot is given in the *RESULT SUMMARY*.

Pk CDE: The *PEAK CODE DOMAIN ERROR* measurement specifies a projection of the difference between the test signal and the ideal reference signal onto the selected spreading factor (see *PEAK CODE DOMAIN ERR* softkey). The Pk CDE value for the selected slot is indicated in the *RESULT SUMMARY*. The spreading factor onto which projection is made is shown beneath the measurement result.

CPICH Slot No: Outputs the number of the CPICH slot at which the measurement is performed (see *SELECT CPICH SLOT* softkey).

No of Active Chan: Indicates the number of active channels detected in the signal. Both the detected data channels and the control channels are considered active channels.

The results of measurements on the selected channel (red in the diagram) are displayed in the lower part of the RESULT SUMMARY.

Symbol Rate: Symbol rate at which the channel is transmitted.

Timing Offset: Offset between the start of the first slot in the channel and the start of the analyzed 3GPP FDD frame.

Channel Code: Number of the spreading code of the selected channel.

Channel Slot No: The channel slot number is obtained by combining the value of the *SELECT CPICH SLOT* softkey and the channel's timing offset.

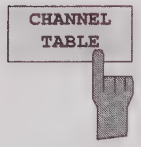
No of Pilot Bits: Number of pilot bits of the selected channel.

Chan Pow rel. / abs.: Channel power relative (referred to CPICH or total signal power) and absolute.

Symbol EVM Pk / rms: Peak or average of the results of the error vector magnitude measurement (see SYMBOL EVM softkey). The measurement provides information on the EVM of the channel (marked red) in the CDP diagram in the slot (marked red) of the power-versus-slot diagram at symbol level.

IEC/IEEE-bus command:

```
:CALCulate2:FEED "XTIM:CDP:ERR:SUMM"
:CALCulate<1|2>:MARKer<1>:FUNCtion:WCDPower:RESult?
        PTOTal | FERRor | TFRame | TOFFset | MACCuracy |
        PCDerror | EVMRms | EVMPeak | CERRor | CSLot |
        SRATe | CHANnel | CDPabsolute | CDPRelative |
        IQOFfset | IQIMbalance
```



The *CHANNEL TABLE* softkey selects the display of the channel assignment table. The channel assignment table can contain a maximum of 512 entries, corresponding to the 512 codes that can be assigned within the class of spreading factor 512.

The upper part of the table indicates the channels that have to be present in the signal to be analyzed. The channel power of the CPICH and PCCPCH is specified. The power of the PSCH and SSCH channels is determined, too. If the signal contains the special channel PICH, it is also listed in the upper part of the table. If the channel table in *CODE CHAN PREDEFINED* mode contains the special channel SCCPCH, this channel is also listed in the upper part of the table.

The lower part of the table indicates the data channels (DPCH) contained in the signal. The channels are in descending order according to symbol rates and within a symbol rate in ascending order according to the channel numbers. Therefore, the unassigned codes are always to be found at the end of the table.

Channel Table SR 30 ksps
Chan Code 69
CF 2.11 GHz CPICH Slot 4 Chan Slot 11

Channel Table

Type	Symb Rate	Chan#	Status	TFCI	PilotL	Pwr Abs	Pwr Rel	T Offs
CPICH	15.0 ksps	0	active	---	---	-10.70	0.00	---
PSCH	-.- ksps	---	active	---	---	-13.69	-2.99	---
SSCH	-.- ksps	---	active	---	---	-13.72	-3.02	---
PCCPCH	15.0 ksps	1	active	---	---	-10.70	-0.00	---
SCCPCH	15.0 ksps	3	active	ON	8	-18.71	-8.01	0
PICH	15.0 ksps	16	active	---	---	-18.67	-7.97	30720
DPCH	30.0 ksps	69	active	ON	8	-19.68	-8.98	22528
DPCH	30.0 ksps	74	active	ON	8	-19.72	-9.02	16640
DPCH	30.0 ksps	78	active	ON	8	-17.71	-7.01	7680
DPCH	30.0 ksps	82	active	ON	8	-19.71	-9.01	9472

Ref 10.0 dBm Att 35 dB 1 CLRWR A SGL TRG

Fig. 6-16 Channel Table

The following parameters of these channels are determined by the CDP measurement:

Type: Type of channel (active channels only)

Symbol Rate: Symbol rate at which the channel is transmitted (7.5 ksps to 960 ksps).

Chan #: Number of channel spreading code (0 to [spreading factor-1])

Status: Status display. Unassigned codes are considered to be inactive.

TFCI: Indication of whether or not the data channel uses TFCI symbols.

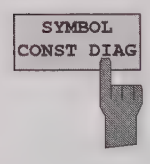
PilotL: Number of pilot bits of the channel.

Pwr Abs / Pwr Rel:
Indication of the absolute and relative channel power (referred to the CPICH or the total power of the signal).

T Offs: Timing offset. Offset between the start of the first slot of the channel and the start of the analyzed 3GPP FDD frame.

In *CODE CHAN AUTOSEARCH MODE*, a data channel is considered to be active if the required pilot symbols (see 3GPP specification, exception: PICH) are to be found at the end of each slot. In addition, the channel should have a minimum power (see *INACT CHAN THRESHOLD* softkey). In *CODE CHAN PREDEFINED* mode, all channels that are included in the user defined channel table are marked as active.

IEC/IEEE-bus command: `:CALCulate<1>:FEED "XTIM:CDP:ERR:CTABle"`



The *SYMBOL CONST* softkey selects the display of symbol constellation diagram. The symbols are displayed for the selected channel (red marking in the CDP diagram) and the selected slot (red marking in the power-versus-slot diagram).

It is possible to display the constellation diagram for unassigned codes (red marking in the CDP diagram on a code represented in blue), but the results are not meaningful, as the unassigned code channel does not contain data.

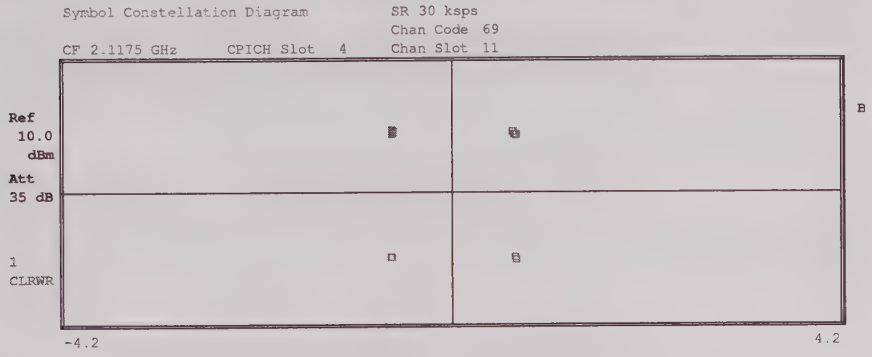
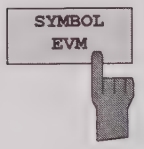


Fig. 6-17 Symbol Constellation Diagram

IEC/IEEE-bus command: `:CALCulate2:FEED "XTIM:CDP:SYMB:CONS"`



The *SYMBOL EVM* softkey activates the symbol error vector magnitude display. The EVM is displayed for the selected channel (red marking in the CDP diagram) and the selected slot (red marking in the power-versus-slot diagram).

It is possible to display the symbol error vector magnitude for unassigned codes (red marking in the CDP diagram on a code represented in blue), but the results are not valid.

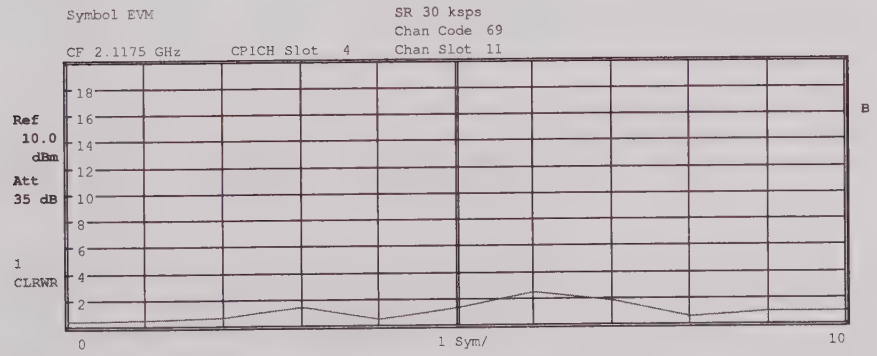


Fig. 6-18 Error Vector Magnitude for the selected slot of the selected channel

IEC/IEEE-bus command: `:CALCulate2:FEED "XTIM:CDP:SYMB:EVM"`

The *BITSTREAM* softkey activates the bitstream display.
The decided bits are displayed for the selected channel (red marking in the CDP diagram) and the selected slot (red marking in the power-versus-slot diagram).

Depending on the channel type and the symbol rate at which the channel is transmitted, specific symbols can be "switched off" in a slot, i.e. power 0 is transmitted instead of these symbols. The results of the bit decision are invalid for such symbols. Such invalid bits are marked by "x" in the diagram.

While it is possible to display the bitstream for unused codes (red marking in the CDP diagramm at a code displayed in blue), the missing data means that the results are not very informative. In this case, "-" is used to indicate that all of the bits are invalid.

In the bit stream diagram, the bits of the individual fields of active data channels are marked in different colours. The colour legend is displayed in the header of the Figure.

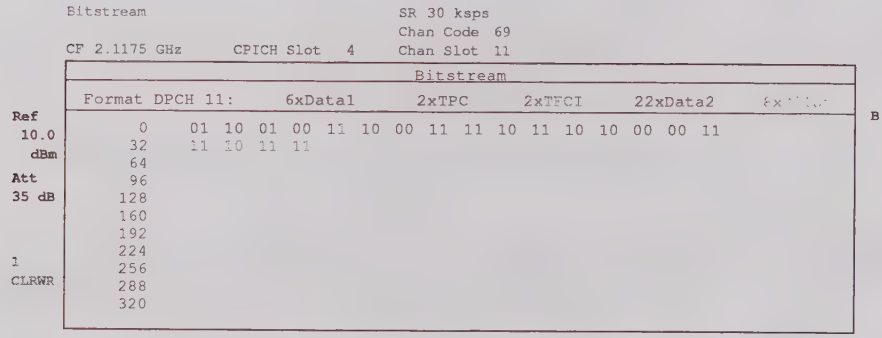


Fig. 6-19 Demodulated bits for the selected slot of the selected channel

IEC/IEEE-bus command: `:CALCulate2:FEED "XTIM:CDP:BSTReam"`

The *SELECT CHANNEL* softkey activates the selection of a channel for the display modes *CDP PWR RELATIVE/ABSOLUTE*, *POWER VS SLOT*, *SYMBOL CONST*, *SYMBOL EVM*.

There are two ways of entering the channel numbers:

- Entry of channel number and spreading factor, separated by a decimal point

If the channel number and the spreading factor are entered simultaneously, the entered channel is selected and marked in red if an active channel is concerned. For the display, the channel number entered is converted on the basis of spreading factor 512. For unused channels, the code resulting from the conversion is marked.

Example: Entry 5.128
Channel 5 is marked at spreading factor 128 (30 ksps) if the channel is active, otherwise code 20 at spreading factor 512.

- Entry of a channel number without a decimal point

In this case, FS-K72 interprets the entered code as based on spreading factor 512. If the code entered corresponds to a used channel, the whole associated channel is marked. If the code corresponds to an unused channel, only the code entered is marked.

Example: Entry 20
Code 20 is marked at spreading factor 512 if there is no active channel on this code. If for instance channel 5 is active at spreading factor 128, the entire channel 5 is marked.

If the entered code corresponds to an active channel, the whole associated channel is marked. If it corresponds to a gap between the channels, only the entered code is marked.
If the code number is modified using the rollkey, the red marking changes its position in the diagram only if the code number no longer belongs to the marked channel. The step width of the changed rollkey position refers to spreading factor 512.

IEC/IEEE-bus command: `:[SENSe:]CDPower:CODE 0 to 511`

The *SELECT CPICH SLOT* softkey activates the selection of the slot number for the display modes *POWER VS SLOT*, *SYMBOL CONST*, *SYMBOL EVM* and *BITSTREAM*.

To avoid ambiguities that may occur due to the permissible timing offsets, the slot number is defined on the basis of the CPICH (i.e. calculated in steps of 2560 chips starting from the beginning of the frame). The desired slot of the selected channel has to be converted according to its timing offset.

Example: Slot 0 of the CPICH is set. The selected channel (red marker in the CDP diagram) has a timing offset of 2816 chips, i.e. slot 0 of the channel is delayed by 2816 chips against the frame start. Slot 0 of the CPICH therefore corresponds to slot 14 of the last frame of the channel.
When the slot number is entered, the red marking in the power-versus-slot diagram changes its position in steps of 2560 chips.

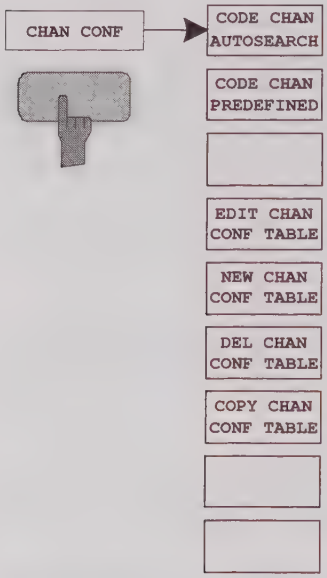
IEC/IEEE-bus command: `:[SENSe:]CDPower:SLOT 0 to 14`

The *ADJUST REF LVL* softkey adjusts the reference level of the FSU to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the FSU or limiting the dynamic range by a too small S/N ratio.

IEC/IEEE-bus command: `SENS:POW:ACH:PRES:RLEV`

Measurement Configuration – *CHAN CONF* hotkey

Hotkey *CHAN CONF*



The *CHAN CONF* hotkey opens a submenu with different configurations for measurements. In this submenu, predefined channel tables can be selected as a basis for code domain measurements.

When the hotkey is selected, a table including the channel tables stored on the measuring instrument's hard disk is opened. The table provides just an overview; a table for the measurement can only be selected after actuating the *CODE CHAN PREDEFINED* softkey.

IEC/IEEE-bus command:

```
:CONFigure:WCDPower[:BTS]:CTABle:CATalog?
```

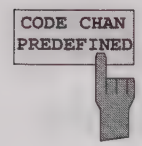
The *CODE CHAN AUTOSEARCH* softkey allows code domain power measurements in the automatic search mode. In this mode, the whole code domain (all permissible symbol rates and channel numbers) is searched for active channels. Detecting an active channel is performed by a comparison with the pilot symbols to be expected after despreading. Only channels with pilot symbols can be detected as active channels. If the pilot symbols of a channel are either missing or incomplete, the channel is not recognized as active. An exception to this rule is the special channel PICH that can be recognized as active channel also in the automatic search mode.

Synchronization channels CPICH, PCCPCH, PSCH and SSCH are assumed to be present by the CDP analysis and added to the channel table for each measurement.

The *CODE CHAN AUTOSEARCH* mode is the preset search mode when starting the CDP analysis. It is mainly intended for giving the user an overview of the channels contained in the signal. If the signal contains channels that are not detected as being active in the automatic search mode, the CDP analysis can be performed with the channel configurations predefined by the user by switching to the *CODE CHAN PREDEFINED* mode.

IEC/IEEE-bus command:

```
CONFigure:WCDPower[:BTS]:CTABle[:STATe] OFF
```



The *CODE CHAN PREDEFINED* softkey activates the predefined channel table mode. No search for active channels in the code domain is performed in this mode, but the channels contained in a channel table defined prior to the measurement are assumed to be active. The code domain power measurement and all further evaluations are carried out for these channels.

On selecting the softkey, a table containing all channel tables stored in the measuring instrument is opened. The CDP analysis is switched to the predefined channel table. When the next measurement is started, the power is measured according to this mode. The last table of the automatic search mode is first taken as a basis for the measurement. This table is available under the *RECENT* entry.

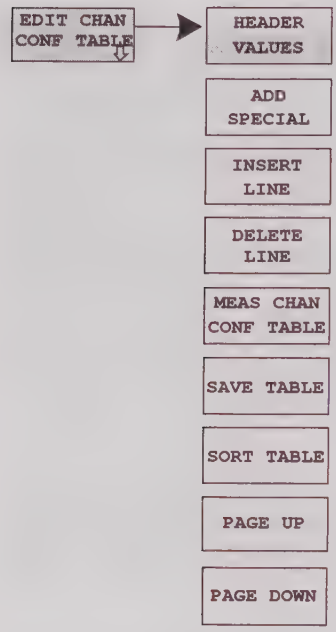
Switching to one of the predefined channel tables is done by selecting the corresponding table entry and pressing one of the unit keys. From the next measurement onwards, the selected channel table is taken as a basis for the sweep. A tick marks the selected channel table.

FS-K72 comes ready with the following channel tables stored on the measuring instrument:

Channel model 1 to 3GPP with 16/32/64 channels
Channel model 2 to 3GPP
Channel model 3 to 3GPP with 16/32 channels
Channel model 4 containing CPICH
Channel model 4 without CPICH

IEC/IEEE-bus command:

```
CONFigure:WCDPower[:BTS]:CTABle[:STATe] ON
CONFigure:WCDPower[:BTS]:CTABle:SELect "3GB_1_32"
```



The *EDIT CHAN CONF TABLE* softkey opens a channel table in which the user can edit the channel configuration. In addition, a submenu is opened giving access to the softkeys required for editing the table.

EDIT CHANNEL TABLE

NAME: 3GB_1_16

COMMENT: 3GPP Base Station Test Case 1 16 Channels

SYMBOL RATE [ksps]	CODE #	USE TFCI	TIMING OFFS. [CHIPS]	PILOT BITS	CDP REL. [dB]	STATUS
PICH	16		30720	---	0.0	ACTIVE
CPICH	0			---	0.0	ACTIVE
PCCPCH	1			---	0.0	ACTIVE
30.0	2	NO	22016	8	0.0	ACTIVE
30.0	11	NO	34304	8	0.0	ACTIVE
30.0	17	NO	13312	8	0.0	ACTIVE
30.0	23	NO	11520	8	0.0	ACTIVE
30.0	31	NO	36608	8	0.0	ACTIVE
30.0	38	NO	28672	8	0.0	ACTIVE
30.0	47	NO	15104	8	0.0	ACTIVE
30.0	55	NO	5888	8	0.0	ACTIVE
30.0	62	NO	256	8	0.0	ACTIVE
30.0	69	NO	22528	8	0.0	ACTIVE
30.0	78	NO	7680	8	0.0	ACTIVE
30.0	85	NO	4608	8	0.0	ACTIVE
30.0	94	NO	7680	8	0.0	ACTIVE
30.0	102	NO	15616	8	0.0	ACTIVE
30.0	113	NO	32768	8	0.0	ACTIVE
30.0	119	NO	36608	8	0.0	ACTIVE

Date: 3.JAN.2001 08:54:31

Fig. 6-20 Table for editing a channel configuration

Basically, any channel table stored on the instrument's hard disk can be edited as required. An edited table is not stored automatically but only after pressing the *SAVE TABLE* softkey. This prevents inadvertent overwriting of a table (e.g. a channel model).

If the user edits the table currently used in CDP analysis, the edited table is taken as a basis for the next measurement immediately after it is stored. The effects of modifications made to the table show, therefore, at once. Here, too, the *SAVE TABLE* softkey must be pressed to store the edited table on the instrument's hard disk.

If the user edits a table stored on the hard disk but currently not active, the modifications become visible only after storage (*SAVE TABLE* softkey) and subsequent activation.

If the SYMBOL RATE or the CHAN # of a channel is changed, the instrument checks for code domain conflicts after confirmation of the entry with one of the unit keys. If a code domain conflict is detected, the channels concerned are marked by an asterisk. The user has the possibility of eliminating the code domain conflict. If a table with code domain conflicts is used in CDP analysis, the results obtained are not valid.

The *HEADER/VALUES* softkey switches between editing the channel table haeder or ist values.

HEADER allows editing the table header, i.e. the name and the comment. By changing the table name, overwriting of a table already stored is prevented. The table name may contain max. 8 characters.

IEC/IEEE-bus command:

```
:CONFigure:WCDPower[:BTS]:CTABle:NAME "NEW_TAB"
```

VALUES allows editing the entries of a channel table. The following parameters are available for each channel of a table (confirm each entry with one of the unit keys):

SYMBOL RATE: Symbol rate at which a channel is transmitted. This entry cannot be edited for channels whose symbol rate is defined by the standard (e.g. synchronization channels). In the case of special channels, the channel type is entered instead of the symbol rate.

CHAN #: Number of channel in the associated transmission class. The validity of the entered channel number for the selected transmission rate is checked on entry; invalid entries are rejected.

USE TFCI: Indicates whether a channel contains TFCI symbols. This information is required for determining the slot format of a channel. The entry cannot be edited for channels containing no TFCI information.

TIMING OFFSET: Timing offset of a channel. The expected timing offset is the channel offset relative to the CPICH, specified in chips.
This entry cannot be edited for channels that have no timing offset.

PILOT BITS: Number of pilot bits of a channel. This information is required for determining the slot format. The entry cannot be edited for channels containing no pilot symbols. The entry is made in bits.

CDP REL.: Information about relative channel power. This entry cannot be edited and exists only for the *RECENT* table; it is used for indicating low-power channels.

STATUS: Channel status (active/inactive). Setting the channel status to inactive excludes a channel entered in the table from CDP analysis without the complete channel line having to be cleared from the table. Only channels with an active status are taken into account in CDP analysis.

IEC/IEEE-bus commands:

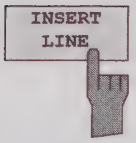
```
:CONFigure:WCDPower[:BTS]:CTABle:DATA
8,0,0,0,0,0,1,0.00,8,1,0,0,0,0,1,0.00,7,1,0,256,
8,0,1,0.00

:CONFigure:WCDPower[:BTS]:CTABle:COMMent
"Comment for new table"
```

The *ADD SPECIAL* softkey is used to add special channels to the channel table. At present, the PICH and SCCPCH special channels, which are included in the 3GPP test models, can be added. Only one channel of each type may be added per channel table.

IEC/IEEE-bus command:

-- (included in `CONF:WCDP:CTAB:DATA` command)



The *INSERT LINE* softkey inserts a new line into the table. In this line, entries can be made in any order. A channel is considered in CDP analysis only if all required entries have been made in the list.

IEC/IEEE-bus command: --

The *DELETE LINE* softkey deletes a marked line from the table.

IEC/IEEE-bus command: --

The *MEAS CHAN CONF TABLE* softkey starts a measurement in the *CODE CHAN AUTOSEARCH* mode. The measurement results are entered in the channel table currently open. This softkey is available only in the *CODE CHAN AUTOSEARCH* mode.

IEC/IEEE-bus command: --

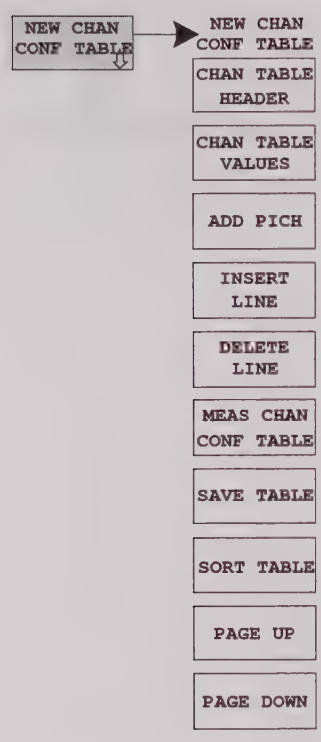
The *SAVE TABLE* softkey saves the table under the specified name. *Caution:* Editing a channel model and storing it under its original name will overwrite the model.

IEC/IEEE-bus command:

-- (automatic storage with remote control)

The *SORT TABLE* softkey sorts a channel table according to symbol rates (in descending order) and, for channels of the same symbol rate, according to channel numbers (in ascending order).

IEC/IEEE-bus command: --



The *NEW CHAN CONF TABLE* softkey opens a submenu identical to that opened by the *EDIT CHAN CONF TABLE* softkey. In contrast to *EDIT CHAN CONF TABLE, NEW CHAN CONF TABLE* opens a table in which only the synchronization channels are entered; the table name is not yet defined.

EDIT CHANNEL TABLE

NAME:

COMMENT:

SYMBOL RATE [ksps]	CODE	#	USE TFCI	TIMING OFFS. [CHIPS]	PILOT BITS	CDP REL. [dB]	STATUS
CPICH	0		NO	0	---	0.0	ACTIVE
PCCPCH	1		NO	0	---	0.0	ACTIVE

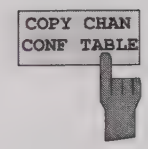
Date: 3.JAN.2001 09:06:19

Fig. 6-21 Creating a new channel configuration

The *DEL CHAN CONF TABLE* softkey deletes a selected table from the list. The table currently active in the *CODE CHAN PREDEFINED* mode cannot be deleted.

IEC/IEEE-bus command:

```
:CONFigure:WCDPower[:BTS]:CTABle:DELete
```



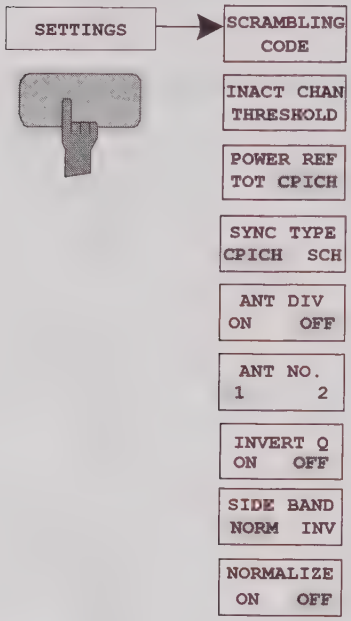
The *COPY CHAN CONF TABLE* softkey copies a selected table. The user is queried to enter the name the copy is to be saved under.

IEC/IEEE-bus command:

```
:CONFigure:WCDPower[:BTS]:CTABle:COPY "CTAB2"
```

Configuration of CDP Measurement – *SETTINGS* hotkey

Hotkey *SETTINGS*



The *SETTINGS* hotkey opens a submenu with softkeys for setting parameters for the CDP measurement.

The *SCRAMBLING CODE* softkey opens a window for entering the scrambling code. The scrambling code is input in hex format.

The entered scrambling code has to coincide with that of the signal. Otherwise, a CDP measurement of the signal is not possible.

IEC/IEEE-bus command: `:[SENSe:]CDPower:LCODe[:VALue] #H2`

The *INACT CHAN THRESH* softkey activates the entry of the minimum power which a single channel should have compared to the total signal in order to be considered an active channel.

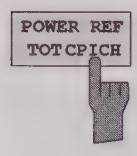
Channels that are below the specified threshold are considered to be not active irrespective of whether they contain pilot symbols or not. Channels that are not active appear in blue colour in the CDP diagram.

The two measurements *COMPOSITE EVM* and *PEAK CODE DOMAIN ERR*, specified as measurements on the total signal, are performed with the aid of the list of active channels. These two measurements are falsified whenever active channels are recognized as not active (see above example) or if unassigned codes get the status "assigned channel". *INACT CHAN THRESHOLD* is therefore used to influence the results of the two measurements.

The default value is -60 dB, which allows all channels of signals like the 3 GPP test signals to be detected in the CDP analysis. If not all channels in the signal are automatically detected, *INACT CHAN THRES* has to be decremented.

IEC/IEEE-bus command:

`:[SENSe:]CDPower:ICTReshold -100dB to +10dB`



The *POWER REF TOT / CPICH* softkey determines the reference power for the relative power displays:

TOT All the relative powers (display modes *CDP RELATIVE* and *POWER VS SLOT*) are referred slot by slot to the total signal power in the slot involved.

CPICH The reference power is that of the CPICH in the relevant slot.

The default setting of the softkey is *CPICH*.

Since 3GPP specifies a slot-specific power control for every channel, the total power of the signal will change from slot to slot in accordance with the power control of the individual channels. As a result, with activated power control and reference to the total power of the signal, a relative CDP display versus the slot number (*POWER VS SLOT*) does not necessarily represent the power control of the selected channel.
Example:
If the signal (theoretically) contains only one data channel whose power is controlled, and if the power is referred to the total power of the signal (which is formed only by the contribution of this data channel), a straight line appears in the *POWER VS SLOT* diagram instead of the expected power staircase. Consequently, the reference value *TOT* of the relative displays is informative only if the signal does not contain power control.
By contrast, the *CPICH* setting also reflects the exact characteristic of the power versus the slot number in a selected channel for signals with power control. Since the CPICH is never power controlled, this yields the same reference value in every slot.

IEC/IEEE-bus command: `:[SENSe:]CDPower:PREFerence TOTal|CPICh`

The *SYNC TYPE CPICH/SCH* softkey allows the user to choose between synchronization with or without CPICH. If *CPICH* is selected, FS-K72 assumes that the CPICH control channel is present in the signal and attempts to synchronize to this channel. If the signal does not contain CPICH (test model 4 without CPICH), synchronization fails.
If *SCH* is selected, FS-K72 synchronizes to the signal without assuming the presence of a CPICH. This setting is required for measurements on test model 4 without CPICH. While this setting can also be used with other channel configurations, it should be noted that the probability of a synchronization failure increases with the number of data channels.
The default setting of the softkey is *CPICH*.

IEC/IEEE-bus command:

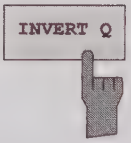
```
:[SENSe<1|2>:]CDPower:STYPe   CPICh | SCHannel
```

The *ANT DIV ON/OFF* softkey activates or deactivates the antenna diversity mode for CDP analysis. If the softkey is set to ON, analysis is carried out with diversity antenna 1 as a default setting (see *ANT NO. 1/2* softkey).
The default setting of the softkey is *OFF*.

IEC/IEEE-bus command: `:[SENSe<1|2>:]CDPower:ANTenna OFF|1|2`

The *ANT NO. 1/2* softkey switches between diversity antennas 1 and 2. Depending on the softkey setting, FS-K72 synchronizes to the CPICH of antenna 1 or antenna 2.
The softkey is available only if the antenna diversity mode is active (*ANT DIV ON/OFF* softkey set to *ON*).
The default setting of the softkey is *1*.

IEC/IEEE-bus command: `:[SENSe<1|2>:]CDPower:ANTenna OFF|1|2`



The *INVERT Q* softkey inverts the sign of the Q component of the signal. In default setting the sogtkey is deactivated.

IEC/IEEE-bus command: `[SENSe:]CDPower:QINVert OFF`

The *SIDE BAND NORM / INV* softkey is used to perform the measurement both in the normal (NORM) and inverted position (INV).

NORM The normal position allows the measurement of RF signals from the base station.

INV The inverted position is useful for measurements on IF modules or components in case of spectral inversion.

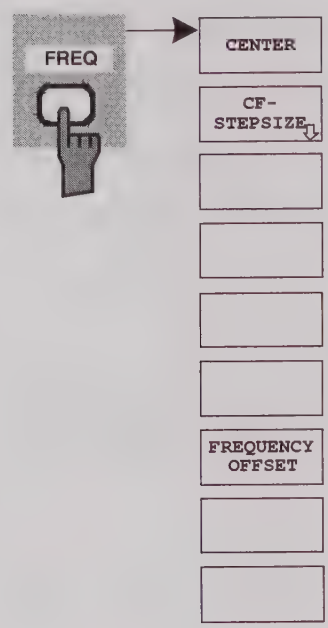
The default setting is *NORM*.

IEC/IEEE-bus command: `:[SENSe:]CDPower:SBANd NORMal|INVers`

The *NORMALIZE ON / OFF* softkey eliminates the DC offset of the signal. Default setting is OFF.

IEC/IEEE-bus command : `[SENSe:]CDPower:NORMalize OFF`

Frequency Settings – Key *FREQ*



The *FREQ* key opens a submenu for changing the measurement frequency.

The *CENTER* softkey opens the window for manually entering the center frequency.
The allowed range of values for the center frequency is:

$$minspan / 2 \leq f_{center} \leq f_{max} - minspan / 2$$

f_{center}	center frequency
minspan	smallest selectable span > 0 Hz (10 Hz)
f_{max}	max. frequency

IEC/IEEE-bus command: `FREQ:CENT 100MHz`

The CF *STEPSIZE* softkey opens a submenu for setting the step size of the center frequency. The step size can be coupled to the span (frequency domain) or the resolution bandwidth (time domain) or it can be manually set to a fixed value. The softkeys are mutually exclusive selection keys.

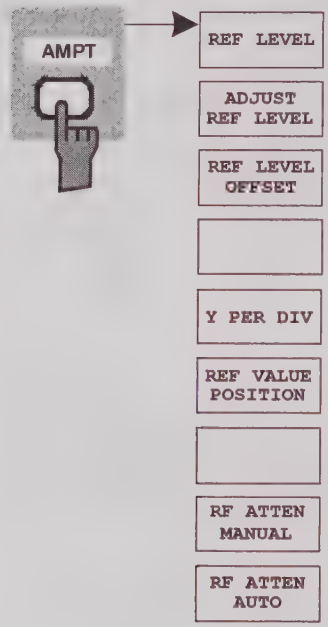
The *FREQUENCY OFFSET* softkey activates the window for entering an arithmetical frequency offset which is added to the frequency axis labelling. The allowed range of values for the offset is -100 GHz to 100 GHz. The default setting is 0 Hz.

IEC/IEEE-bus command: `FREQ:OFFS 10 MHz`

Span Settings – Key *SPAN*

The *SPAN* key is disabled for measurements in the CDP mode. For all other measurements (see MEAS key), the permissible span settings are described with the relevant measurement. The associated menu corresponds to that of the measurement in the basic unit and is described in the manual of the basic unit.

Level Settings – Key *AMPT*



The *AMPT* key opens a submenu for level setting.

The *REF LEVEL* softkey allows the reference level to be input in the currently active unit (dBm, dBµV, etc).

IEC/IEEE-bus command: `DISP:WIND:TRAC:Y:RLEV -60dBm`

ADJUST REF LVL executes a routine for optimum adjustment of the reference level to the signal.

IEC/IEEE-bus command:
`[SENSe<1|2>:]CDPower:LEVel:ADJust`

The *REF LEVEL OFFSET* softkey allows the arithmetic level offset to be entered. This offset is added to the measured level irrespective of the selected unit. The scaling of the Y-axis is changed accordingly.
The setting range is ±200 dB in 0.1 dB steps.

IEC/IEEE-bus command:
`DISP:WIND:TRAC:Y:RLEV:OFFS -10dB`

Y PER DIV determines the grid spacing on the Y axis for all diagrams, where possible.

IEC/IEEE-bus command:
`DISPlay[:WINDow<1|2>]:TRACe<1..3>:Y[:SCALe]:RPOSition`

REF VALUE POSITION allows entry of the position of the reference value on the Y axis (0 – 100%).

IEC/IEEE-bus command:
`DISPlay[:WINDow<1|2>]:TRACe<1..3>:Y[:SCALe]:PDIVision`

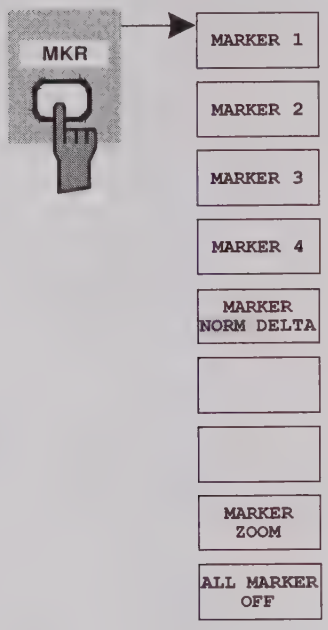
The *RF ATTEN MANUAL* softkey allows the attenuation to be entered irrespective of the reference level.
The attenuation can be set in 10 dB steps between 0 and 70 dB (in 5 dB steps between 0 and 75 dB if option FSU-B25, *Electronic Attenuator*, is fitted). Other entries will be rounded to the next lower integer value.
If the defined reference level cannot be set for the given RF attenuation, the reference level will be adjusted accordingly and the warning "Limit reached" will be output.

IEC/IEEE-bus command: `INP:ATT 40 DB`

The *RF ATTEN AUTO* softkey sets the RF attenuation automatically as a function of the selected reference level.
This ensures that the optimum RF attenuation desired by the user is always used.
RF ATTEN AUTO is the default setting.

IEC/IEEE-bus command: `INP:ATT:AUTO ON`

Marker Settings – Key *MKR*



The *MARKER* key opens a submenu for the marker settings.

Markers are not available for the *RESULT SUMMARY* and *CHANNEL TABLE* displays. In all other displays, up to four markers can be activated, which can be defined as marker or delta marker by means of the *MARKER NORM/DELTA* softkey.

The *MARKER 1/2/3/4* .softkey selects the corresponding marker and activates it.
MARKER 1 is always the normal marker. After they have been switched on, *MARKERS 2 to 4* are delta markers that refer to *MARKER 1*. These markers can be converted into markers with absolute value display by means of the *MARKER NORM DELTA* softkey. When *MARKER 1* is the active marker, pressing the M*ARKER NORM DELTA* softkey switches on an additional delta marker.
Pressing the *MARKER 1 to 4* softkey again switches off the selected marker.

IEC/IEEE-bus command:

```
CALC:MARK ON;
CALC:MARK:X <value>;
CALC:MARK:Y?
CALC:DELT ON;
CALC:DELT:MODE ABS|REL
CALC:DELT:X <value>;
CALC:DELT:X:REL?
CALC:DELT:Y?
```

The *MARKER ZOOM* softkey expands the area around the active marker. With the zoom function, more details of the measurement signal can be seen.
The softkey *MARKER ZOOM* can only be selected, if at least one of the markers is activated.
If an instrument setting is changed after selection of *MARKER ZOOM*, the function is aborted.

IEC/IEEE-bus command: `CALC:MARK1:FUNC:ZOOM`

The *ALL MARKER OFF* softkey switches off all markers (reference and delta markers). It also switches off all functions and displays associated with the markers/delta markers.

IEC/IEEE-bus command: `CALC:MARK:AOFF`

The parameters of an activated marker are output on top of the diagram:

```
Marker 1 [T1 ]
                          -6.02 dBm
    Slot  4 SR 30.00 ksps Ch 62
```

Fig. 6-22 Parameters of the marker info field

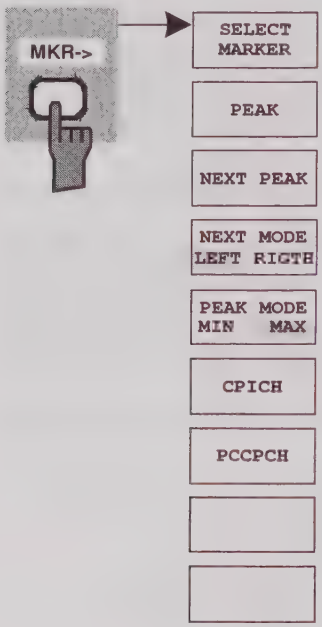
Besides the channel power, which is displayed relative to the value specified with *POWER REF TOT/CPICH*, the parameters are:

Slot 4: Slot number of the channel (unassigned codes have a timing offset of 0 chip referred to beginning of the frame)

SR 30 ksps:
Symbol rate of the channel (for unassigned codes 7.5 ksps)

Ch 62: Number of the spreading code of the channel

Changing Instrument Settings – Key *MKR→*



The *MKR→* key opens a submenu for marker functions:

The *SELECT MARKER* softkey activates the numerical selection of the marker in the data entry field. Delta marker 1 is selected by input of ' 0 '.

IEC/IEEE-bus command:
```
CALC:MARK1 ON;
CALC:MARK1:X <value>;
CALC:MARK1:Y?
```

The *PEAK* softkey sets the active marker or delta marker to the peak of the trace.
If no marker is active when *MKR->* menu is called, *MARKER 1* is automatically switched on and the peak search is performed.

IEC/IEEE-bus command:
```
CALC:MARK:MAX
CALC:DELT:MAX
```

The *NEXT PEAK* softkey sets the active marker/delta marker to the next lower peak value on the trace. The search direction is defined in the *NEXT MODE* submenu (see below).

IEC/IEEE-bus command:
```
CALC:MARK:MAX:NEXT
CALC:DELT:MAX:NEXT
CALC:MARK:MIN:NEXT
CALC:DELT:MIN:NEXT
```

The *NEXT MODE LEFT/RIGHT* softkey defines the direction in which the next higher maximum or minimum is searched for. For *NEXT MODE LEFT/RIGHT* the search is done left/right of tha active marker.

IEC/IEEE-bus command:
```
CALC:MARK:MAX:LEFT
CALC:DELT:MAX:LEFT
CALC:MARK:MIN:LEFT
CALC:DELT:MIN:LEFT
CALC:MARK:MAX:RIGH
CALC:DELT:MAX:RIGH
CALC:MARK:MIN:RIGH
CALC:DELT:MIN:RIGH
```

The *PEAK MODE MIN/MAX* softkey defines if the next minimum or maximum peak should be searched for. The parameter influences the behaviour of the softkeys *PEAK* and *NEXT PEAK*.

IEC-Bus-Befehl: --

The *MARKER -> CPICH* sets the marker to the common pilot channel (code number 0 for spreading factor 256; corresponds to displayed code numbers 0 and 1 of the x-axis).

IEC/IEEE-bus commands:
```
:CALCulate<1|2>:MARKer<1>:FUNCtion:CPICh
:CALCulate<1|2>:MARKer<1>:Y?
```

The *MARKER -> PCCPCH* sets the marker to the primary common control physical channel (code number 1 for spreading factor 256; corresponds to displayed code numbers 2 and 3 of the x-axis).

IEC/IEEE-bus commands:
```
:CALCulate<1|2>:MARKer<1>:FUNCtion:PCCPch
:CALCulate<1|2>:MARKer<1>:Y?
```

Marker Functions – Key MKR *FCTN*

The *MKR FCTN* key is disabled for all measurements in the code domain power. For all other FS-K72 measurements, the menu softkeys are described in the manual of the basic unit.

Bandwidth Setting – Key *BW*

The *BW* key is disabled for all measurements in the code domain power. For all other FS-K72 measurements, the menu-specific softkeys are described in the manual of the basic unit.

Measurement Control – Key *SWEEP*

The menu of the *SWEEP* key contains options for switchover between single measurement and continuous measurement and for the control of individual measurements. For measurements within the spectrum, the measurement time for a sweep can also be set. All menu-specific softkeys are described in the manual of the basic unit.

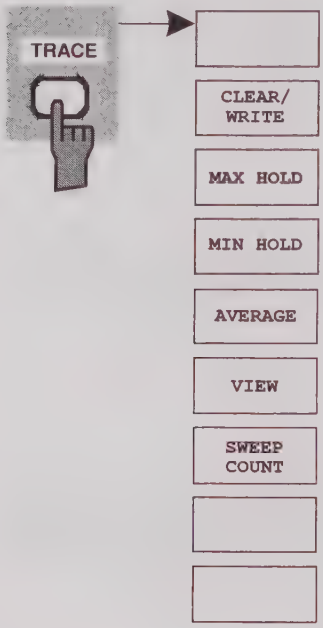
Measurement Selection – Key *MEAS*

The menu of the *MEAS* key contains all the FS-K72 measurements, which can be selected at a keystroke. The menu and its submenus are described in chapter 6.

Trigger Settings – Key *TRIG*

The selectable trigger functions depend on the measurement selected. Code domain power measurements allow the free run mode as well as the frame trigger mode specified by the 3GPP standard. For all other measurements, the trigger modes are identical to those of the corresponding measurement in the basic unit. The associated softkeys are described in the manual of the basic unit.

Trace Settings – Key *TRACE*



The Key *TRACE* opens the following submenu:

The *CLEAR/WRITE* softkey activates the overwrite mode for the collected measured values, i.e. the trace is overwritten by each sweep.
In the *CLEAR/WRITE* display mode all the available detectors can be selected. In the default mode the autopeak detector (setting *AUTO*) is selected.
Each time the *CLEAR/WRITE* softkey is actuated, FSU clears the selected trace memory and starts the measurement anew.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE WRIT`

The *MAX HOLD* softkey activates the max peak detector.
FSU saves the sweep result in the trace memory only if the new value is greater than the previous one.
The signal spectrum is filled up upon each sweep until all signal components are detected in a kind of envelope.
Pressing the *MAX HOLD* softkey again clears the trace memory and restarts the max hold mode.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE MAXH`

The *MIN HOLD* softkey activates the min peak detector.
FSU saves the sweep result in the trace memory only if the new value is greater than the previous one.
The signal spectrum is filled up upon each sweep until all signal components are detected in a kind of envelope.
Pressing the *MIN HOLD* softkey again clears the trace memory and restarts the max hold mode.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE MINH`

The *AVERAGE* softkey activates the trace averaging function. The average is formed over several sweeps. Averaging can be performed with any of the detectors available. If the detector is automatically selected by FSU, the sample detector is used.
Averaging is restarted every time the *AVERAGE* softkey is pressed. The trace memory is always cleared.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE AVER`

The *VIEW* softkey freezes the current contents of the trace memory and displays it.
If a trace is frozen by *VIEW*, the instrument settings can be changed without the displayed trace being modified (exception: level display range and reference level, see below). The fact that the trace and the current instrument setting do not agree any more is indicated by an enhancement label "*" at the right edge of the grid.
If in the *VIEW* display mode the level display range (*RANGE*) or the reference level (*REF LEVEL*) are changed, FSU automatically adapts the measured data to the changed display range. This allows an amplitude zoom to be made after the measurement in order to show details of the trace.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE VIEW`

The *SWEEP COUNT* softkey activates the entry of the number of sweeps

used for averaging. The allowed range of values is 0 to 30000 and the following should be observed:

- Sweep Count = 0 means running averaging
- Sweep Count = 1 means no averaging being carried out
- Sweep Count > 1 means averaging over the selected number of sweeps; in the continuous sweep mode averaging is performed until the set number of sweeps is attained and is then continued as running averaging.

The default setting is running averaging (Sweep Count = 0). The number of sweeps used for averaging is the same for all active traces in the selected diagram.

IEC/IEEE-bus command `SWE:COUN 64`

Display Lines – Key *LINES*

The *LINES* key is disabled for all measurements in the code domain power. For all other measurements, the menu settings are equivalent to those of the corresponding measurement in the basic unit; the associated softkeys are described in the manual of the basic unit.

Settings of Measurement Screen – Key *DISP*

The menu of the *DISP* key contains softkeys for the configuration of the measurement screen. The menus and the softkey functions are described in the manual of the basic unit.

Storing and Loading of Unit Data – Key *FILE*

The *FILE* menu is identical to that of the basic unit. All softkeys are described in the manual of the basic unit.

All keys of the FSU front panel that are not specifically mentioned are identical to those of the basic unit. The key functions and the softkeys are described in the manual of the basic unit.

7 Remote-Control Commands

The following chapter describes the remote-control commands for the application firmware. An alphabetical list at the end of this chapter provides an overview of the commands.

The commands, which are also valid for the basic unit in the signal analyzer mode as well as the system settings, are described in the operating manual of the analyzer.

CALCulate:FEED - Subsystem

The CALCulate:FEED subsystem selects the evaluation method for the measured data. This corresponds to the result display selection in manual operation.

COMMAND	PARAMETER	UNIT	COMMENT
CALCulate<1|2> :FEED	<string>		
:XPOWer			
:CDP			
[:ABSolute]			
:RATio			
:XTIMe			
:CDPower			
:ERRor			
:SUMMary			
:CTABle			
:PCDomain			
:MACCuracy			
:PVSLot			
:BSTReam			
:SYMBol			
:CONStellation			
:EVM			

:CALCulate<1|2>:FEED <string>

This command selects the measured data that are to be displayed. .

Parameter: <string>::= 'XPOW:CDP' |
'XPOW:CDP:RAT' |
'XTIM:CDP:MACCuracy' |
'XTIM:CDP:PVSLot' |
'XTIM:CDP:BSTReam' |
'XTIM:CDP:ERR:SUMM' |
'XTIM:CDP:ERR:CTABle' |
'XTIM:CDP:ERR:PCDomain' |
'XTIM:CDP:SYMB:CONStellation' |
'XTIM:CDP:SYMB:EVM'

,

Example: `":CALC2:FEED 'XTIM:CDP:MACCuracy'"`

Features: *RST value: 'XTIM:OFF' (vector signal analysis)
SCPI: conforming

Note: *For code domain power (CDP) measurements, the display is always operated in the SPLIT SCREEN mode and the assignment of display mode to measurement window is fixed. Therefore, the numeric suffix that is required or permitted is given in brackets for each display mode.*

The string parameters have the following meaning:

'XPOW:CDP'	Result display of code domain power as bargraph (CALCulate<1>)
'XPOW:CDP:RAT'	Result display of code domain power ratio as bargraph (CALCulate<1>)
'XTIM:CDP:ERR:SUMM'	Result display in tabular form (CALCulate2)
'XTIM:CDP:ERR:CTABle'	Result display of channel assignment table (CALCulate<1>)
'XTIM:CDP:ERR:PCDomain'	Result display of peak code domain error (CALCulate2)
'XTIM:CDP:MACCuracy'	Result display of composite EVM (error vector magnitude referred to the overall signal) (CALCulate2)
'XTIM:CDP:PVSLot'	Result display of power versus slot (CALCulate2)
'XTIM:CDP:BSTReam'	Result display of bit stream (CALCulate2)
'XTIM:CDP:SYMB:CONStellation'	Result display of symbol constellation (CALCulate2)
'XTIM:CDP:SYMB:EVM'	Result display of symbol error vector magnitude (CALCulate2)

CALCulate:LIMit – Subsystem

COMMAND	PARAMETER	UNIT	COMMENT
CALCulate:LIMit:ESPectrum :MODE :VALue	 AUTO | MANual | USER 43 | 39 | 31 | 0		

:CALCulate:LIMit:ESPectrum:MODE AUTO | MANual | USER

This command activates or deactivates automatic selection of the limit line in the spectrum emission mask measurement.

Parameters:

AUTO	The limit line is set as a function of the measured channel power.
MANUAL	One of the four predefined limit lines is set. The selection is made with the command CALC:LIM:ESP:VAL.
USER	Query only; user-defined limit lines are active (refer to description of limit lines in manual for basic unit).

Example: ":CALC:LIM:ESP:MODE AUTO"

Features:

*RST value:	AUTO
SCPI:	device-specific

:CALCulate:LIMit:ESPectrum:VALue <numeric_value>

This command activates manual selection of the limit line. This means that one of the four possible limit lines is selected by specifying the expected power range as a value:

Specified value in dBm:	Selected limit line:	Value returned on query:
Value ≥ 43	P ≥ 43	43
39 ≤ value < 43	39 ≤ P < 43	39

31 ≤ value < 39	31 ≤ P < 39	31
Value < 31	P < 31	0

Example: ":CALC:LIM:ESP:VALue 39"

Features: *RST value: 0
SCPI: device-specific

CALCulate:MARKer – Subsystem

COMMAND	PARAMETER	UNIT	COMMENT
CALCulate<1|2> :MARKer<1...4> :FUNCtion :CPICh :PCCPch :WCDPower [:BTS] :RESult?	PTOTal | FERRor | TFRame | TOFFset | MACCuracy | PCDerror | EVMRms | EVMPeak | CERRor | CSLot | SRATe | CHANnel | CDPabsolute | CDPRelative | IQOFfset | IQIMbalance		

:CALCulate<1|2>:MARKer<1>:FUNCtion:CPICh

This command sets the marker to channel 0.

Example: ":CALC:MARK:FUNC:CPIC"

Features: *RST value: _
SCPI: device-specific

This command is an <Event> and has therefore neither *RST value nor query. Only the numeric suffix 1 is permissible in MARKer.

The numeric suffix in CALCulate that is required or permissible depends on the selected display mode for which the marker is to be valid and has to coincide with it:

CALCulate<1> for CDP absolute and relative

CALCulate2 for composite EVM, peak code domain error, power versus slot, bit stream, symbol constellation and EVM

:CALCulate<1|2>:MARKer<1>:FUNCtion:PCCPch

This command sets the marker to channel 1.

Example: ":CALC:MARK:FUNC:PCCP"

Features: *RST value: _
SCPI: device-specific

This command is an <Event> and has therefore neither *RST value nor query. Only the numeric suffix 1 is permissible in MARKer.

The numeric suffix in CALCulate that is required or permissible depends on the selected display mode for which the marker is to be valid and has to coincide with it:

CALCulate<1>	for CDP absolute and relative
CALCulate2	for composite EVM, peak code domain error, power versus slot, bit stream, symbol constellation and EVM

:CALCulate<1>:MARKer<1>:FUNCtion:WCDPower[:BTS]:RESult?
PTOTal | FERRor | TFRame | TOFFset | MACCuracy | PCDerror | EVMRms | EVMPeak | CERRor | CSLot | SRATe | CHANnel | CDPabsolute | CDPRelative | IQOFfset | IQIMbalance

This command queries the measured and calculated results of the 3GPP FDD code domain power measurement.

Example: `":CALC:MARK:FUNC:WCDP:RES? PTOT"`

Features: *RST value: -
SCPI: device-specific

PTOTal	total power	FERRor	frequency error in Hz
TFRame	trigger to frame	TOFFset	timing offset
MACCuracy	composite EVM	PCDerror	peak code domain error
EVMRms	error vector magnitude RMS	EVMPeak	error vector magnitude peak
CERRor	chip rate error	CSLot	channel slot number
SRATe	symbol rate	CHANnel	channel number
CDPabsolute	channel power absolute	CDPRelative	channel power relative
IQOFfset	IQ offset	IQIMbalance	IQ imbalance

CALCulate:STATistics - Subsystem

The CALCulate:STATistics subsystem controls the statistical measurement functions in the instrument. The measurement window cannot be selected with these functions. The numeric suffix in CALCulate is therefore ignored.

COMMAND	PARAMETER	UNIT	COMMENT
:CALCulate			
:STATistics			
[:BTS]			
:CCDF			
[:STATe]	<Boolean>		
:NSAMples	<numeric_value>	--	
:SCALe			
:Y			
:UPPer	<numeric_value>	--	
:LOWer	<numeric_value>	--	

:CALCulate:STATistics[:BTS]:CCDF[:STATe] ON | OFF

This command switches on or off the measurement of the complementary cumulative distribution function (CCDF).

Example: `"CALC:STAT:CCDF ON"`

Features: *RST value: OFF
SCPI: device-specific

:CALCulate:STATistics:NSAMples 100 to 32768

This command sets the number of measurement points to be acquired for the statistical measurement functions

Example: "CALC:STAT:NSAM 5000"

Features: *RST value: 10000
SCPI: device-specific

:CALCulate:STATistics:SCALe:Y:UPPer 1E-5 to 1.0

This command defines the upper limit for the Y-axis of the diagram in statitistical measurements. Since probabilities are specified on the Y-axis, the entered numerical values are dimensionless.

Example: "CALC:STAT:SCAL:Y:UPP 0.01"

Features: *RST value: 1.0
SCPI: device-specific

:CALCulate:STATistics:SCALe:Y:LOWer 1E-6 to 0.1

This command defines the lower limit for th Y-axis of the diagram in statistical measurements. Since probabilities are specified on the Y-axis, the entered numerical values are dimensionless.

Example: "CALC:STAT:SCAL:Y:LOW 0.001"

Features: *RST value: 1E-6
SCPI: device-specific

CONFigure:WCDPower Subsystem

This subsystem comprises the commands for configuring the code domain power measurements. Only the numeric suffix 1 is permissible in CONFigure.

COMMAND	PARAMETER	UNIT	COMMENT
CONFigure			
:WCDPower			
[:BTS]			Option FS-K72
:MEASurement	POWer | ACLR | ESPectrum | OBANdwidth | OBWidth | WCDPower | CCDF		
:CTABle			
[:STATe]	<Boolean>		
:SELect	<file_name>		
:NAME	<file_name>		
:DATA	AUTO | <numeric_value>, AUTO | <numeric_value>..		
:COMMent	<string>		
:COPY	<file_name>		
:DELete			
:CATalog?			

CONFigure<1>:WCDPower[:BTS]:MEASurement POWer | ACLR| ESPectrum | OBANdwith | OBWidth | WCDPower | CCDF

This command selects the 3GPP FDD base station tests. The settings of the predefined measurements are described for the associated softkey in chapter 6.

Parameter:	POWer	Channel power measurement (standard 3GPP WCDMA Forward) with predefined settings
	ACLR	Adjacent channel power measurement (standard 3GPP WCDMA Forward) with predefined settings
	ESPectrum	Measurement of spectrum emission mask
	OBANdwith | OBWidth	Measurement of occupied power bandwidth
	WCDPower	Code domain power measurement. This selection has the same effect as command `INSTrument:SELect WCDPower`.
	CCDF	Measurement of Complementary Cumulative Distribution Function
Example:	`"CONF:WCDP:MEAS POW"`	
Features:	*RST value:	POWer
	SCPI:	device-specific

CONFigure:WCDPower[:BTS]:CTABle[:STATe] ON | OFF

This command switches the channel table on or off. On switching on, the measured channel table is stored under the name RECENT and switched on. After the RECENT channel table is switched on, another channel table can be selected with the command `CONF:WCDP:CTABle:SELect`.

Note: *The RECENT channel table must always be switched on first with the command* `CONF:WCDP:CTAB:STAT` *and then the required channel table can be selected with the command* `CONF:WCDP:CTAB:SEL`

Example:	`":CONF:WCDP:CTAB ON"`	
Features:	*RST value:	OFF
	SCPI:	device-specific

CONFigure:WCDPower[:BTS]:CTABle:SELect <string>

This command selects a predefined channel table file. Before using this command, the RECENT channel table must be switched on first with the command `CONF:WCDP:CTAB:STATe ON`.

Example:	`":CONF:WCDP:CTABle ON"`	
	`":CONF:WCDP:CTAB:SEL 'CTAB_1'"`	
Features:	*RST value:	"RECENT"
	SCPI:	device-specific

:CONFigure:WCDPower[:BTS]:CTABle:NAME <file_name>

This command selects an existing channel table or creates the name of a new channel table.

Example:	`":CONF:WCDP:CTAB:NAME 'NEW_TAB'"`	
Features:	*RST value:	"RECENT"
	SCPI:	device-specific

:CONFigure:WCDPower[:BTS]:CTABle:DATA
2..9,0..511,0 | 1,<numeric_value> | AUTO,2 | 4 | 8 | 16,0 | 1,<numeric_value>...

This command defines the values of the selected channel table.

Each line of the table consists of 8 values:
<code class>,<code number>,<use TFCI>,<timing offset | AUTO>,<pilot length>,<pitch>,<status>,<CDP relative [dB]>....

Code class:	2 to 9	
Code number:	0 to 511	
use TFCI:	0: not used, 1: used	
Timing offset:	0 to 38400, for code class 9, the step width is 512, else 256,	
Pilot length:	code class 9:	4
	code class 8:	2, 4, 8
	code class 7:	4, 8
	code class 5/6:	8
	code class 2/3/4	16
PICH:	0: normal channel, 1: PICH channel	
Status:	0: not active, 1:active	
CDP relative:	for setting commands any value, for query CDP relative value	

Channels PICH, CPICH and PCCPCH may only be defined once. If channel CPICH or PCCPCH is missing in the command, it is automatically added at the end of the table.

Prior to this command, the name of the channel table has to be defined with command `CONF:WCDP:CTAB:NAME`.

Example: `":CONF:WCDP:CTAB:DATA 8,0,0,0,0,0,1,0.00, 8,1,0,0,0,0,1,0.00,7,1,0,256,8,0,1,0.00"`
2 channels are defined: CPICH, PCCPCH and a channel in code class 7

Features: *RST value: -
SCPI: device-specific

:CONFigure:WCDPower[:BTS]:CTABle:COMMent <string>

This command defines a comment for the selected channel table

Prior to this command, the name of the channel table has to be defined with command `CONF:WCDP:CTAB:NAME` and the values of the table have to be defined with command `CONF:WCDP:CTAB:DATA`.

Example: `":CONF:WCDP:CTAB:COMM 'Comment for table 1'"`

Features: *RST value: ""
SCPI: device-specific

:CONFigure:WCDPower[:BTS]:CTABle:COPY <file_name>

This command copies one channel table onto another one. The channel table to be copied is selected with command `CONF:WCDP:CTAB:NAME`.

Parameter: <file_name> ::= name of the new channel table

Example: `":CONF:WCDP:CTAB:COPY 'CTAB_2'"`

Features: *RST value: --
SCPI: device-specific

The name of the channel table may contain a maximum of 8 characters. This command is an "event" which is why it is not assigned an *RST value and has no query.

:CONFigure:WCDPower[:BTS]:CTABle:DELete

This command deletes the selected channel table. The channel table to be deleted is selected with command `CONF:WCDP:CTAB:NAME`.

Example: `":CONF:WCDP:CTAB:DEL"`

Features: *RST value: --
SCPI: device-specific

This command is an "event" which is why it is not assigned an *RST value and has no query.

:CONFigure:WCDPower[:BTS]:CTABle:CATalog?

This command reads out the names of all channel tables stored on the harddisk.

Syntax of output format:

<Sum of file lengths of all subsequent files>,<free memory on hard disk>,
<1st file name>,,<1st file length>,<2nd file name>,,<2nd file length>,....,<nth file name>,
<nth file length>

Example: `":CONF:WCDP:CTAB:CAT?"`

Features: *RST value: --
SCPI: device-specific

INSTrument Subsystem

:INSTrument[:SELect] SANalyzer | RECeiver | ADEMod | MSGM | CDPower | **WCDPower|BWCDpower**

This command switches between the operating modes by means of text parameters.

Selection BWCDpower or WCDPower presets the instrument as described in Chapter 2, Section "Basic Settings in Code Domain Measurement Mode".

Example: `":INST BWCD"`

Features: *RST value: SANalyzer
SCPI: conforming

SENSe:CDPower Subsystem

This subsystem controls the parameters for the code domain mode. The numeric suffix in `SENSe<1|2>` is not significant in this subsystem.

COMMAND	PARAMETER	UNIT	COMMENT
[SENSe<1|2>]			
:CDPower			Option FS-K72
:ICTReshold	<numeric_value>	dB	
:SBANd	NORMal | INVerse		
:LEVel			
:ADJust			
:LCODe			
[:VALue]	<hex>	--	
:CODE	<numeric_value>	--	
:SLOT	<numeric_value>	--	
:SFACtor	4 | 8 | 16 | 32 | 64 | 128 | 256 | 512	--	
:NORMalize	<Boolean>	--	
:QINVert	<Boolean>	--	
:PREFerence	TOTal | CPICh	--	
:STYPe	CPICh | SCHannel	--	
:ANTenna	OFF | <numeric_value>	--	

:[SENSe:]CDPower:SFACtor 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512

This command defines the spreading factor. The spreading factor is only significant for display mode PEAK CODE DOMAIN ERROR.

Example: `":SENS:CDP:SFACtor 16"`

Features: *RST value: 512
SCPI: device-specific

:[SENSe:]CDPower:CODE 0 to 511

This command sets the code number. The code number refers to code class 9 (spreading factor 512).

Example: `":SENS:CDP:CODE 30"`

Features: *RST value: 0
SCPI: device-specific

:[SENSe:]CDPower:NORMalize ON | OFF

This command switches elimination of IQ offset on or off.

Example: `":SENS:CDP:NORM OFF"`

Features: *RST value: OFF
SCPI: device-specific

Mode: WCDP

:[SENSe:]CDPower:QINVert ON | OFF

This command inverts the Q component of the signal.

Example: ":SENS:CDP:QINV ON"

Features: *RST value: OFF
SCPI: device-specific

Mode: WCDP

:[SENSe:]CDPower:SLOT 0 to 14

This command sets the slot number of the common pilot channels (CPICH).

Example: ":SENS:CDP:SLOT 3"

Features: *RST value: 0
SCPI: device-specific

:[SENSe:]CDPower:SBANd NORMal | INVers

This command is for interchanging the left and the right sideband.

Example: ":CDP:CDP:SBAN INV"

Features: *RST value: NORM
SCPI: device-specific

Mode: WCDP

:[SENSe:]CDPower:LCODe[:VALue] #H0 to #H1fff

This command defines the scrambling code in hexadecimal format.

Example: ":CDP:LCOD #H2"

Features: *RST value: 0
SCPI: device-specific

:[SENSe:]CDPower:ICTReshold -100 dB to + 10 dB

This command sets the threshold value from which a channel is treated as active. The level entered refers to the total signal power.

Example: ":CDP:ICTR -10DB"

Features: *RST value: -60 dB
SCPI: device-specific

:[SENSe:]CDPower:PREFerence TOTal | CPICh

This command switches between the use of total power or CPICH power as reference for the relative CDP measurement values.

Example: ":SENS:CDP:PREF CPIC"

Features: *RST value: TOTal
SCPI: device-specific

:[SENSe<1|2>:]CDPower:STYPe CPICh | SCHannel

This command selects the type of synchronization.

CPICH Synchronization to CPICH (default setting). For this type of synchronization, the CPICH must be present in the transmit signal.

SCH Synchronization without CPICH. This type of synchronization is required for test model 4 without CPICH.

Example: `":CDP:STYP SCH"`

Features: *RST value: CPICh
SCPI: device-specific

:[SENSe<1|2>:]CDPower:ANTenna OFF | 1 | 2

This command activates or deactivates the antenna diversity mode and selects the antenna to be used.

OFF The antenna diversity mode is switched off.

1 | 2 The antenna diversity mode is switched on, and the signal from antenna 1 or antenna 2 is used for CDP analysis.

Example: `":CDP:ANT 1"`

Features: *RST value: OFF
SCPI: device-specific

TRACe Subsystem

:TRACe[:DATA] TRACE1 | TRACE2 | ABITstream | PWCDp

This command transfers trace data from the controller to the instrument, the query reads trace data out of the instrument.

Example:
```
":TRAC TRACE1,"+A$    (A$: data list in current format)
":TRAC? TRACE1"
```

Features: *RST value: -
SCPI: conforming

TRACE1, TRACE2, CTABle, PWCDp or ABITstream can be queried depending on the display mode.

ABITstream can be set only if `CALC2:FEED "XTIM:CDP:BSTReam"` is selected (in the lower bitstream window). This command returns the bitstreams of all 15 slots one after the other, the output format may be REAL, UINT or ASCII.

PWCDp can be set if CODE PWR ABSOLUTE / RELATIVE , CHANNEL TABLE is selected for Trace 1. The pilot length is transmitted in addition to the values as transmitted for TRACE1. The pilot length is given in symbols.
Six values are transmitted for each channel:
< class>,<cannel number>,<absolute level>,<relative level>,<timing offset> or <I/Q-mapping>, <pilot length>,...

CTABle can be set if CODE PWR ABSOLUTE / RELATIVE , CHANNEL TABLE is selected for Trace 1. The pilot length and the channel state (active, inactive) are transmitted in addition to the values as transmitted for TRACE1. The pilot length is given in symbols.
Seven values are transmitted for each channel:

< class>,<cannel number>,<absolute level>,<relative level>,<timing offset>,<pilot length>, <active|inactive>...

For TRACE1 or TRACE2 the following measured values are transferred depending on the display mode:

CODE PWR ABSOLUTE / RELATIVE , CHANNEL TABLE (TRACE1)

Each channel is defined by the class, the channel number, the absolute level, the relative level and the timing offset. The class denotes the spreading factor of the channel.

Class 9 corresponds to the highest spreading factor (512, symbol rate 7.5 ksps), class 2 to the lowest admissible spreading factor (4, symbol rate 960 ksps).

Five values are transmitted for each channel.

<class>,<cannel number>,<absolute level>,<relative level>,<timing offset>, ...

For CODE PWR ABSOLUTE / RELATIVE, the channels are output in ascending order sorted according to the code numbers, i.e in the same sequence as they are displayed on the screen. For CHANNEL TABLE, the channels are sorted according to the code classes, i.e. the unassigned channels are transmitted last.

The units are:

Absolute level	dBm,
Relative level	dB referred to CPICH or total power.
Timing offset	chips

The example shows the results of a query for three channels with the following configuration:

1st channel: spreading factor 512, channel number 7, timing offset 0
2nd channel: spreading factor 4, channel number 1, timing offset 256 chips
3rd channel: spreading factor 128, channel number 255, timing offset 2560 hips

This yields the following result: 9,7,-40,-20,0,2,1,-40,-20,256,7,255,-40,-20,2560

The channels come in the same order as in the CDP diagram, i.e. depending on their position in the code domain of spreading factor 512

RESULT SUMMARY (TRACE2)

The results of the RESULT SUMMARY are output in the following order:

<composite EVM>,<peak CDE>,<carr freq Error>,<chip rate error>,
<total power>,<trg to frame>,<EVM peak channel>,<EVM mean channel>, <class>,
<channel number>,<power abs. channel>,<power rel. channel>,<timing offset>,
<IQ offset>,<IQ imbalance>

The units are:

EVM peak channel/mean channel, composite EVM, IQ offset/imbalance : %,

Peak CDE, total power and power abs. channel dB.

Power rel. Channel	dB referred to CPICH or total power.
Carr freq error :	Hz
Chip Rate Error	ppm.
Timing offset	chips
Trg to Frame	µs.

POWER VS SLOT (TRACE2)

16 pairs of slot (slotnumber of CPICH) and level values (for 16 slots) are always transferred.
<slot number>, <level value in dB>,<slot number>,<level value in dB>,....

SYMBOL EVM (TRACE2)

The number of level values depends on the spreading factor:

Spreading factor 512	5 values
Spreading factor 256	10 values
Spreading factor 128	20 values
Spreading factor 64	40 values
Spreading factor 32	80 values
Spreading factor 16	160 values
Spreading factor 8	320 values
Spreading factor 4	640 value

PEAK CODE DOMAIN ERR and COMPOSITE EVM (TRACE2)

15 pairs of slot (slotnumber of CPICH) and values are always transferred.
PEAK CODE DOMAIN ERR: <slot number>, <level value in dB>,.....
COMPOSITE EVM: <slot number>, <lvalue in %>, ...

SYMBOL CONST(TRACE2)

The real and the imaginary part are transferred as a pair:
<re 0>,<im 0>,<re 1>,<im 1>,.....<re n>, <im n>

The number of level values depends on the spreading factor:

Spreading factor 512	5 values
Spreading factor 256	10 values
Spreading factor 128	20 values
Spreading factor 64	40 values
Spreading factor 32	80 values
Spreading factor 16	160 values
Spreading factor 8	320 values
Spreading factor 4	640 value

BITSTREAM (TRACE2)

The bitstream of one slot is transferred. One value is transferred per bit (range 0,1,). Each symbol contains of two consecutive bits. The number of symbols is not constant and may vary for each sweep. Specific symbols in the bitstream may be invalid depending on the channel type and the bit rate (symbols without power). The assigned invalid bits are marked by "9".

Example for a bitstream trace: 0,1,0,9,0,1, ...

Alphabetical List of Commands

Command	Parameter
:CALCulate<1|2>:FEED	'XPOW:CDP' 'XPOW:CDP:RAT' 'XTIM:CDP:MACCuracy' 'XTIM:CDP:PVSLot' 'XTIM:CDP:BSTReam' 'XTIM:CDP:ERR:CTABle' 'XTIM:CDP:ERR:SUMM' 'XTIM:CDP:ERR:PCDomain' 'XTIM:CDP:SYMB:CONStellation' 'XTIM:CDP:SYMB:EVM'
:CALCulate:LIMit:ESPectrum:MODE	AUTO | MANual | USER
:CALCulate:LIMit:ESPectrum:VALue	<numeric_value>

Command	Parameter
:CALCulate<1|2>:MARKer<1>:FUNCtion:CPICH	
:CALCulate<1|2>:MARKer<1>:FUNCtion:PCCPch	
CALCulate<1>:MARKer<1>:FUNCtion:WCDPower[:BTS]:RESult?	PTOTal | FERRor | TFRame | TOFFset | MACCuracy | PCDerror | EVMRms | EVMPeak | CERRor | CSLot | SRATe | CHANnel | CDPabsolute | CDPRelative | IQOFfset | IQIMbalance
:CALCulate:MARKer:Y:PERCent	0 to 100%
:CALCulate:STATistics[:BTS]:CCDF[:STATe]	ON | OFF
:CALCulate:STATistics:NSAMples	100 to 32768
:CALCulate:STATistics: SCALe:Y:LOWer	-1E-6 to 0.1
:CALCulate:STATistics:SCALe:Y:UPPer	-1E-5 to 1.0
:CONFigure<1>:WCDPower[:BTS]:MEASurement	POWer | ACLR | ESPectrum | OBANdwidth|OBWidth | WCDPower | CCDF
:CONFigure<1>:WCDPower[:BTS]:CTABle:CATAlog?	
:CONFigure<1>:WCDPower[:BTS]:CTABle:COMMent	<string>
:CONFigure<1>:WCDPower[:BTS]:CTABle:COPY	<file_name>
:CONFigure<1>:WCDPower[:BTS]:CTABle:DATA	2 to 9, 0 to 511, 0 | 1, <numeric_value> | AUTO, 2|4|8|16 , 0|1, <numeric_value>....
:CONFigure<1>:WCDPower[:BTS]:CTABle:DELete	
:CONFigure<1>:WCDPower[:BTS]:CTABle:NAME	<file_name>
:CONFigure<1>:WCDPower[:BTS]:CTABle:SELect	<string>
:CONFigure<1>:WCDPower[:BTS]:CTABle[:STATe]	ON | OFF
:INSTrument[:SELect]	WCDPower|BWCDpower
:[SENSe:]CDPower:ANTenna	OFF | 1 | 2
:[SENSe:]CDPower:CODE	0 to 511
:[SENSe:]CDPower:ICTReshold	–50 to 10 dB
:[SENSe:]CDPower:LCODe[:VALue]	#H0 to #H1fff
:[SENSe:]CDPower:LEVel:ADJust	
:[SENSe:]CDPower:NORMalize	ON | OFF
:[SENSe:]CDPower:PREFerence	TOTal | CPICh
:[SENSe:]CDPower:PRESet	
:[SENSe:]CDPower:QINVert	ON | OFF
:[SENSe:]CDPower:SBANd	NORMal | INVers
:[SENSe:]CDPower:SFACtor	4 | 8 | 16 | 32 | 64 | 128 | 256 | 512
:[SENSe:]CDPower:SLOT	0 .to 14
:[SENSe:]CDPower:STYPe	CPICh | SCHannel
:TRACe[:DATA]	TRACE1| TRACE2 | ABITstream | PWCDp

Table of Softkeys with Assignment of IEC/IEEE Commands

3G FDD BS

```
INSTrument:SELect BWCDpower|WCDPower
```

POWER

```
:CONFigure<1>:WCDPower:MEASurement POWer
```

Query of results: `:CALCulate<1>:MARKer<1>:FUNCtion:POWer:RESult? CPOWer`

ACLR

```
:CONFigure<1>:WCDPower:MEASurement ACLR
```

Query of results: `:CALCulate<1>:MARKer<1>:FUNCtion:POWer:RESult? ACPower`

SPECTRUM EM MASK

```
:CONFigure:WCDPower:MEASurement ESPectrum
```

Query of results: `:CALCulate<1>:LIMit<1>:FAIL?`

LIMIT LINE AUTO

```
:CALCulate<1>:LIMit<1>:ESPectrum:MODE AUTO
```

LIMIT LINE MANUAL

```
:CALCulate<1>:LIMit<1>:ESPectrum:MODE MANual
:CALCulate<1>:LIMit<1>:ESPectrum:VALue <numeric_value>
```

LIMIT LINE USER

```
:CALCulate:LIMit<1>:NAME <string>
:CALCulate:LIMit<1>:UNIT DBM
:CALCulate:LIMit<1>:CONTrol[:DATA] <num_value>, <num_value>, ...
:CALCulate:LIMit<1>:CONTrol:DOMain FREQuency
:CALCulate:LIMit<1>:CONTrol:TRACe 1
:CALCulate:LIMit<1>:CONTrol:OFFset <num_value>
:CALCulate:LIMit<1>:CONTrol:MODE   RELative

:CALCulate:LIMit<1>:UPPer[:DATA] <num_value>, <num_value>..
:CALCulate:LIMit<1>:UPPer:STATe   ON | OFF
:CALCulate:LIMit<1>:UPPer:OFFset <num_value>
:CALCulate:LIMit<1>:UPPer:MARGin <num_value>
:CALCulate:LIMit<1>:UPPer:MODE  ABSolute
:CALCulate:LIMit<1>:UPPer:SPACing LINear
```

Hinweise:

- Werden die y-Werte mit dem Befehl `:CALCulate:LIMit<1>:LOWer[:DATA]` eingegeben, dann ergibt der Limit-Check "failed", wenn die Grenzwertlinie unterschritten wird.
- Wird eine benutzerdefinierte Grenzwertlinie eingeschaltet, dann hat diese Vorrang vor Grenzwertlinien, die mit AUTO und MANUAL ausgewählt wurden.

OCCUPIED BANDWIDTH

```
:CONFigure<1>:WCDPower:MEASurement OBANdwidth
```

Query of results: `:CALCulate<1>:MARKer<1>:FUNCtion:POWer:RESult? OBANdwidth`

STATISTICS

```
:CONFigure:WCDPower:MEASurement CCDF      oder
:CALCulate:STATistics[:BTS]:CCDF[:STATe] ON
```

Query of results: `CALCulate:MARKer:X?`

PERCENT MARKER

```
:CALCulate:MARKer:Y:PERCent 0...100%
```

NO OF SAMPLES

```
CALCulate:STATistics:NSAMamples 1...32768
```

AVERAGE ON OFF

```
:DISPlay[:WINDow]:TRACe<1>:MODE  AVERage | VIEW
```

SWEEP COUNT

```
:[SENSe<1|2>:]:SWEep:COUNt 6
```

Y MAX

```
:CALCulate:STATistics:SCALe:Y:UPPer 1E-5..1
```

Y MIN

```
:CALCulate:STATistics:SCALe:Y:LOWer 1E-6..0.1
```

CODE DOM POWER

```
:INSTrument<1>[:SELect] WCDPower
```
oder
```
:CONFigure:WCDPower:MEASurement WCDPower

Query of results:
        :TRACe:DATA?  TRACE1 | TRACE2 | ABITstream | PWCDp

or      :CALCulate<1|2>:MARKer<1>:FUNCtion:WCDPower:RESult?
              PTOTal | FERRor |TFRame | TOFFset | MACCuracy |
              PCDerror | EVMRms | EVMPeak | CERRor | CSLot | SRATe |
              CHANnel | CDPabsolute | CDPRelative | IQOFfset |
              IQIMbalance
```
or marker functions (see submenu MARKER)

CHAN CONF

--

CODE CHAN AUTOSEARCH

```
:CONFigure:WCDPower[:BTS]:CTABle[:STATe] OFF
```

CODE CHAN PREDEFINED

```
:CONFigure:WCDPower[:BTS]:CTABle[:STATe] ON
:CONFigure:WCDPower[:BTS]:CTABle:SELect  <channel table name>
```

EDIT CHAN CONF TABLE

CHAN TABLE HEADER

```
:CONFigure:WCDPower[:BTS]:CTABle:NAME "channel table name"
:CONFigure:WCDPower[:BTS]:CTABle:COMMent "Comment for new table"
```

CHAN TABLE VALUES

```
:CONFigure:WCDPower[:BTS]:CTABle:NAME "channel table name"
:CONFigure:WCDPower[:BTS]:CTABle:DATA <numeric_value>
```

ADD SPECIAL

--

INSERT LINE

--

DELETE LINE

--

MEAS CHAN CONF TABLE

--

SAVE TABLE

-- (erfolgt bei Fernbedienung automatisch)

SORT TABLE

--

NEW CHAN CONF TABLE

Siehe EDIT CHAN CONF TABLE

DEL CHAN CONF TABLE

```
:CONFigure:WCDPower[:BTS]:CTABle:NAME "channel table name"
:CONFigure:WCDPower[:BTS]:CTABle:DELete
```

COPY CHAN CONF TABLE

```
:CONFigure:WCDPower[:BTS]:CTABle:NAME "channel table name"
:CONFigure:WCDPower[:BTS]:CTABle:COPY "new channel table name"
```

SETTINGS

--

SCRAMBLING CODE

```
:[SENSe:]CDPower:LCODe[:VALue] #H0 ... #H1fff<hex>
```

INACT CHAN THRESH

```
:[SENSe:]CDPower:ICTReshold -50 dB ... +10 dB
```

POWER REF TOT CPICH	:[SENSe:]CDPower:PREFerence TOTal | CPICh
SYNC TYPE CPICH SCH	:[SENSe:]CDPower:STYPe CPICHh | SCHannel
ANT DIV ON OFF	:[SENSe:]CDPower:ANTenna OFF | 1 | 2
ANT NO. 1 2	:[SENSe:]CDPower:ANTenna OFF | 1 | 2
INVERT Q	:[SENSe:]CDPower:QINVert ON | OFF
SIDE BAND NORM INV	:[SENSe:]CDPower:SBANd NORMal | INVerse
NORMALIZE ON OFF	:[SENSe:]CDPower:NORMalize ON | OFF
RESULTS	--
CODE PWR RELATIVE	:CALCulate<1>:FEED 'XPOW:CDP:RAT'
CODE PWR ABSOLUTE	:CALCulate<1>:FEED 'XPOW:CDP'
COMPOSITE EVM	:CALCulate2:FEED "XTIM:CDP:MACCuracy"
PEAK CODE DOMAIN ERR	:CALCulate2:FEED "XTIM:CDP:ERR:PCDomain"
POWER VS SLOT	:CALCulate2:FEED "XTIM:CDP:PVSLot"
RESULT SUMMARY	:CALCulate2:FEED "XTIM:CDP:ERR:SUMMary" Query of results: :CALCulate:MARKer:FUNCtion:WCDPower[:BTS]:RESult? PTOTal | FERRor | TFRame | TOFFset | MACCuracy | PCDerror | EVMRms | EVMPeak | CERRor | CSLOt | SRATe | CHANnel | CDPabsolute | CDPRelative | IQOFfset | IQIMbalance
SELECT PCDE SF	:[SENSe:]CDPower:SFACtor 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512
SELECT CHANNEL	:[SENSe:]CDPower:CODE 0...511
SELECT CPICH SLOT	:[SENSe:]CDPower:SLOT 0 ... 14
CHANNEL TABLE	:CALCulate<1>:FEED "XTIM:CDP:ERR:CTABle"
SYMBOL CONST DIAG	:CALCulate2:FEED "XTIM:CDP:SYMB:CONStellation"
SYMBOL EVM	:CALCulate2:FEED "XTIM:CDP:SYMB:EVM"
BITSTREAM	:CALCulate2:FEED "XTIM:CDP:SYMB:BITStream"

8 Performance Test

- Switch off FSU before removing or inserting modules.
- Check the setting of the AC supply voltage selector (230 V) prior to switching on the unit.
- Measure the parameters after a warm-up time of at least 30 min. and the completion of system error correction of FSU and SMIQ. Only then is it ensured that the specifications are complied with.
- Unless specified otherwise all settings are made after a PRESET.
- Conventions for settings on FSU during the measurement:

[***<Key>***]	Press a key on the front panel, eg [SPAN]
[<SOFTKEY>]	Press a softkey, eg [MARKER -> PEAK]
[<nn unit>]	Enter a value and terminate by entering the unit, eg [12 kHz]
{<nn>}	Enter values indicated in one of the following tables.

Successive entries are separated by [:], eg [***SPAN***: 15 kHz].

- The values stated hereinafter are not guaranteed values. Only the data sheet specifications are binding.

Required Measuring Equipment and Accessories

Table 8-1 Required Measuring Equipment and Accessories

Item	Instrument type	Recommended characteristics	Recommended equipment	R&S Order No.	Use
1	Signal generator	Vector signal generator for generating cdmaOne signals	SMIQ with options: SMIQB42 SMIQB20 SMIQB11	1125.5555.xx 1104.7936.02 1125.5190.02 1085.4502.04	

Test Procedure

The performance test refers exclusively to results of the code-domain power.
It is not required to check the POWER-, ACLR- and SPECTRUM results since they are covered by the performance test of the basic unit.

Default settings on SMIQ:

[PRESET]
[LEVEL : *0 dBm]*
[FREQ: *2.1175 GHz]*
DIGITAL STD
WCDMA 3GPP
TEST MODELS ...
TEST1_32
SELECT BS/MS
BS 1 ON
STATE: ON

Trigger output: *RADIO FRAME*

Check set channels against the following table:

CHNO	TYPE	SYM.R	CH.CD	POW	DATA	TOFFS	PILOT	TPC	MC	STATE
0	P-CPICH	15	0	-10.0					OFF	ON
2	P-SCH	15		-13.0					OFF	ON
3	S-SCH	15		-13.0					OFF	ON
4	P-CCPCH	15	1	-10.0	PN9					ON
6	PICH	15	16	-15.0	PATT	120				ON
11	DPCH	30	2	-13.0	PN9	86	8	PATTOFF		ON
12	DPCH	30	11	-13.0	PN9	134	8	PATTOFF		ON
13	DPCH	30	17	-14.0	PN9	52	8	PATTOFF		ON
14	DPCH	30	23	-15.0	PN9	45	8	PATTOFF		ON
15	DPCH	30	31	-17.0	PN9	143	8	PATTOFF		ON
16	DPCH	30	38	-14.0	PN9	112	8	PATTOFF		ON
17	DPCH	30	47	-16.0	PN9	59	8	PATTOFF		ON
18	DPCH	30	55	-18.0	PN9	23	8	PATTOFF		ON
19	DPCH	30	62	-16.0	PN9	1	8	PATTOFF		ON
20	DPCH	30	69	-19.0	PN9	88	8	PATTOFF		ON
21	DPCH	30	78	-17.0	PN9	30	8	PATTOFF		ON
22	DPCH	30	85	-15.0	PN9	18	8	PATTOFF		ON
23	DPCH	30	94	-17.0	PN9	30	8	PATTOFF		ON
24	DPCH	30	102	-22.0	PN9	61	8	PATTOFF		ON
25	DPCH	30	113	-20.0	PN9	128	8	PATTOFF		ON
26	DPCH	30	119	-24.0	PN9	143	8	PATTOFF		ON
27	DPCH	30	7	-20.0	PN9	83	8	PATTOFF		ON
28	DPCH	30	13	-18.0	PN9	25	8	PATTOFF		ON
29	DPCH	30	20	-14.0	PN9	103	8	PATTOFF		ON
30	DPCH	30	27	-14.0	PN9	97	8	PATTOFF		ON
31	DPCH	30	35	-15.0	PN9	56	8	PATTOFF		ON
32	DPCH	30	41	-19.0	PN9	104	8	PATTOFF		ON
33	DPCH	30	51	-18.0	PN9	51	8	PATTOFF		ON
34	DPCH	30	58	-17.0	PN9	26	8	PATTOFF		ON
35	DPCH	30	64	-22.0	PN9	137	8	PATTOFF		ON
36	DPCH	30	74	-19.0	PN9	65	8	PATTOFF		ON
37	DPCH	30	82	-19.0	PN9	37	8	PATTOFF		ON
38	DPCH	30	88	-16.0	PN9	125	8	PATTOFF		ON
39	DPCH	30	97	-18.0	PN9	149	8	PATTOFF		ON
40	DPCH	30	108	-15.0	PN9	123	8	PATTOFF		ON
41	DPCH	30	117	-17.0	PN9	83	8	PATTOFF		ON
42	DPCH	30	125	-12.0	PN9	5	8	PATTOFF		ON

all other channels STATE OFF

Default settings on FSU:

[PRESET]
[CENTER: *2.1175 GHz]*
[REF: *10 dBm]*
[3G FDD BS]
[TRIG *EXTERN]*
[SETTINGS SCRAMBLING CODE 0]
[DISPLAY CHANNEL TABLE]

Test setup and other settings

- Connect external trigger input of FSU to SMIQ
- Connect external reference output of FSU to SMIQ

SMIQ

UTILITIES

REF OSC

SOURCE: EXT

FSU

[SETUP:

REFERENCE INT]

The display of the FSU should show the following:

Channel Table SR 30 ksps
Chan Code 69
CF 2.1175 GHz CPICH Slot 0 Chan Slot 7

Channel Table

Type	Symb Rate	Chan#	Status	TFCI	PilotL	Pwr Abs	Pwr Rel	T Offs
CPICH	15.0 ksps	0	active	---	---	-10.19	-0.00	---
PSCH	-.- ksps	---	active	---	---	-16.29	-6.10	---
SSCH	-.- ksps	---	active	---	---	-15.85	-5.67	---
PCCPCH	15.0 ksps	1	active	---	---	-10.18	0.01	---
------	-.- ksps	---	inactv	---	---	-.--	-.--	---
PICH	15.0 ksps	16	active	---	---	-18.20	-8.02	30720
DPCH	30.0 ksps	69	active	ON	8	-19.16	-8.97	22528
DPCH	30.0 ksps	74	active	ON	8	-19.20	-9.01	16640
DPCH	30.0 ksps	78	active	ON	8	-17.19	-7.00	7680
DPCH	30.0 ksps	82	active	ON	8	-19.19	-9.00	9472

Ref 10.0 dBm Att 35 dB 1 CLRWR A TRG PRN EXT B

Result Summary SR 30 ksps
Chan Code 69
CF 2.1175 GHz CPICH Slot 0 Chan Slot 7

Result Summary

GLOBAL RESULTS			
Total Power	-0.26 dBm	Carrier Freq Error	-83.91 mHz
Chip Rate Error	0.01 ppm	Trigger to Frame	0.00 s
IQ Offset	0.19 %	IQ Imbalance	0.06 %
Composite EVM	1.41 % rms	Pk CDE (15.0 ksps)	-57.83 dB rms
CPICH Slot No	0	No of Active Chan	35
CHANNEL RESULTS			
Symbol Rate	30.00 ksps	Timing Offset	22528 Chips
Channel Code	69	Channel Slot No	7
No of Pilot Symb	8		
Channel Power Rel	-8.97 dB	Channel Power Abs	-19.16 dBm
Symbol EVM	1.10 % rms	Symbol EVM	1.78 % Pk

Ref 10.0 dBm Att 35 dB 1 CLRWR

Date: 14.DEC.2001 13:39:42

9 Glossary

CPICH	Common pilot channel (spreading code number 0 at spreading factor 128) The channel constantly contains the symbol (1,1) throughout the total length of the 3GPP FDD frame. For the measurements, the CPICH (Primary CPICH) is used for synchronization. For this reason, the CPICH must be contained in the signal to be measured.
Composite EVM	In accordance with the 3GPP specifications, the squared error between the real and imaginary parts of the test signal and an ideal reference signal is determined (EVM referred to the total signal) in a composite EVM measurement.
DPCH	Dedicated physical channel, data channel. The data channels, which can be sent at different transmission rates, are automatically recognized during the measurement.
Inactive Channel Threshold	Minimum power that a single channel must have as compared to the total signal to be recognized as an active channel
PCCPCH	Primary common control physical channel (spreading code number 1 at spreading factor 128) The channel is used for synchronizing the measurements. For this reason, it must be contained in the signal to be measured.
Peak Code Domain Error	In accordance with the 3GPP specifications, the error between the test signal and the ideal reference signal is projected onto the classes of the different spreading factors in the case of a peak code domain measurement.
PICH	Paging indication channel This special channel is defined in the test models to 3GPP for measurements on base station signals. Since it does not contain any pilot symbols, it cannot automatically be recognized during the measurement. Therefore this channel must be deactivated for CDP measurements.
SCH	Synchronization channel, divided into P-SCH (Primary Synchronization Channel) and S-SCH (Secondary Synchronization Channel). The two channels are required for synchronizing the measurement. Therefore they must always be contained in the signal to be measured.
Timing offset	Offset between the start of the first slot of a channel and the start of the analyzed 3GPP FDD frame (in multiples of 256 chips).

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